

**THE FEDERAL PROGRAM FOR THE DISPOSAL OF  
SPENT NUCLEAR FUEL AND HIGH-LEVEL  
RADIOACTIVE WASTE**

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**HEARING**  
BEFORE THE  
SUBCOMMITTEE ON NUCLEAR REGULATION  
OF THE  
COMMITTEE ON  
ENVIRONMENT AND PUBLIC WORKS  
UNITED STATES SENATE  
ONE HUNDRED FIRST CONGRESS  
SECOND SESSION

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OCTOBER 2, 1990  
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Printed for the use of the  
Committee on Environment and Public Works



U.S. GOVERNMENT PRINTING OFFICE  
WASHINGTON : 1990

36-663

For sale by the Superintendent of Documents, Congressional Sales Office  
U.S. Government Printing Office, Washington, DC 20402

5321-7

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# THE FEDERAL PROGRAM FOR THE DISPOSAL OF SPENT NUCLEAR FUEL AND HIGH-LEVEL RADIOACTIVE WASTE

TUESDAY, OCTOBER 2, 1990

U.S. SENATE,  
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS,  
SUBCOMMITTEE ON NUCLEAR REGULATION,  
Washington, DC.

The committee met, pursuant to notice, at 9:39 a.m. in room 406, Dirksen Senate Office Building, Hon. Bob Graham [acting chairman of the subcommittee] presiding.

Present: Senators Graham, Reid, Simpson, Symms, and Bryan.

## OPENING STATEMENT OF HON. BOB GRAHAM, U.S. SENATOR FROM THE STATE OF FLORIDA

Senator GRAHAM. Good morning. The subject of today's hearing is the Federal Program for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste.

This is the final hearing this year in a series of hearings held by the Subcommittee on the major issues affecting the future of American nuclear power. At previous hearings, we looked at electricity supply and demand, the standardization of nuclear plant designs and the licensing process for nuclear powerplants. I intend to consider the testimony from all these hearings in developing, with my colleagues, the Subcommittee's legislative and oversight agenda for next year.

The importance of developing and maintaining a sound national energy policy is being underscored, on a daily basis, by the domestic energy effects of the Persian Gulf crisis. For example, an article in Sunday's Washington Post states that the steep rise in the price of oil—now almost \$40 per barrel—is not based on the economics of supply and demand, but rather is mostly based on uncertainty about the future. We need a national energy strategy to reduce this type of uncertainty. We need to be flexible in our energy supplies so that we can avoid crisis of uncertainty when there is an interruption of one type of supply.

We need to rely on alternatives. At present, nuclear power is not an alternative without significant uncertainties of its own. In the first two hearings we have explored some of the reasons why this is the fact.

It appears that some important steps have already been taken to reduce some of the institutional factors contributing to the uncertainty about nuclear power. For example, the NRC has issued a

new rule on standardized design certifications. This is a step in the right direction.

There is still, however, many other major uncertainties with the future of nuclear power. Perhaps none is more important than the fate of spent nuclear fuels and high-level radioactive waste. What will happen on nuclear waste is one of the biggest unanswered questions about nuclear power.

Today's hearing will look at what is being done to solve the nuclear waste problem. Nuclear power can be a key ingredient of our national energy policy, but we must be able to dispose of nuclear waste safely if it is to be a realistic option. We need as many realistic options as possible to preserve and protect our economic and environmental security.

The Nuclear Waste Program has been controversial from the start. It has also been very expensive. We have spent over \$2 billion and have not even begun a formal characterization of a site.

A premise for our national nuclear waste disposal policy has been that permanent, deep geologic disposal is the safest place to put our highly radioactive nuclear waste. An issue today will be the continued validity of that premise. To the extent that this premise does continue to be valid, it is imperative that we have a program define a geologic repository. Unfortunately, the programs that we have had have not been satisfactory. Today, we will look at where the current program is, how it got there, and where it is going. We will also be looking at whether any changes are necessary.

The hearing is intended to be a broad hearing on the general status of the legal, political, and technical issues facing the program. There will be ample time in the future for the Subcommittee to focus on more specific issues. The Subcommittee welcomes the input of any person who has an interest in any part of the program.

At this time, I would like to welcome our distinguished witnesses who will be appearing today. As you can see, we are meeting in an informal round table fashion, which has been our pattern for the two previous hearings. The purpose of this is to allow for a full interchange between the members of the Committee and the panelists and among the panelists. That has been very helpful in our previous hearings and we look forward to the same benefits today.

I would like to introduce the panelists. This would be the order in which I would request that you would make your opening statements. Mr. Robert Bernero, Director, Office of Nuclear Materials Safety and Safeguards, NRC; Doctor Michael Shapiro, Deputy Assistant Administrator for Air and Radiation, EPA; Doctor Don U. Deere, Chairman, U.S. Nuclear Waste Technical Review Board; Doctor Charles Fairhurst, Vice Chairman, Board on Radioactive Waste Management, National Research Council; Doctor Robert Loux, Executive Director, Nuclear Waste Project Office for the State of Nevada; Mr. Allen Keesler, President and Chief Executive Officer, Florida Power Corporation; Honorable Michael Wilson, Chairman of the Florida Public Service Commission; and Honorable John W. Bartlett, Director, Office of Civilian Radioactive Waste Management of the Department of Energy.

We have, obviously, a full list of panelists. I would ask each of the panelists to condense their remarks for oral presentation to five minutes. The full statement will be included as part of the record.

We are joined by two of our colleagues, one of whom is a member of the Environment and Public Works Committee, Senator Harry Reid of Nevada.

Senator Reid.

#### OPENING STATEMENT OF HON. HARRY REID, U.S. SENATOR FROM THE STATE OF NEVADA

Senator REID. Thank you very much, Mr. Chairman.

I am pleased to participate in today's discussion concerning public policy on high-level radioactive waste disposal. This issue is more important to Nevada than all the other 49 States. While we have no nuclear powerplants, at this time we have been singled out as the heir apparent to the Nation's high-level radioactive waste. Bequeathed by this Nation's will, Nevadans have been offered an opportunity they rightly want to refuse. The Nation's will is Nevada's won't.

The nuclear waste issue is like a festering sore in Nevada. It is a technical and political controversy. Both issues must be addressed to reach a satisfactory conclusion. We cannot engineer or force-fit a solution on a weak foundation. The preliminary scientific assessments have concluded that Yucca Mountain site is an active volcano. Memories of Mount Saint Helens should convince all of us that an active volcano is not a firm foundation to house a waste repository. An unbiased scientific assessment into the geologic stability of the Yucca Mountain site would have difficulty refuting this authoritative conclusion.

There are serious questions regarding the impartiality of the parties involved. The fundamental questions are: is a fair hearing possible on the scientific prospects of a 10,000 year installation, or will the process be subject to pressure by the Administration and the industry, trampling over a deliberate and methodical investigation?

This Committee has the oversight responsibility for the two agencies—the United States Nuclear Regulatory Commission and the United States Environmental Protection agency—which will set the criteria and standards that will ensure that the high-level waste repository—wherever it's located—will be designed, constructed, and operated in a fashion that will pose no undue risk to the public.

Whether we, as individuals, are pleased with the public policy that nuclear power is an essential element of our Nation's electrical generating capacity, nuclear power and its waste are here to stay for the foreseeable future. Given the renewed instability in the Middle East, as the Chairman of the Subcommittee has mentioned, the impact of the Clean Air Act on the power industry, and the challenges facing us with global climate change, the nuclear option may—and I repeat, may—have the opportunity to become a player in our Nation's energy mix in the decades to come.

The trust and confidence of the public are essential if nuclear power is expected to be rejuvenated or if it is to be retained as part



of this Nation's energy mix. The days of Government scientists in white laboratory coats saying, "Trust me," and claiming that Three Mile Island can't happen are long gone. Until, and unless, we resolve the nuclear waste issue, a cloud of doubt will remain on the nuclear option.

Recently, the National Academy of Sciences and the National Academy of Engineering's National Research Council, one of the organizations that specifically provides advice to the Government on science issues, offered their perspective on the efforts to develop a high-level waste repository. The NRC's Board on Radioactive Waste Management reported that the current approach to construct a repository is "bound to fail" because it expects what science cannot deliver today, certainty.

I reject any consideration that the proposed nuclear dump should be a grand experiment that we can refine on a trial and error basis. If you recall, the last failed experiment in the nuclear industry was a place called Chernobyl. The American people, I don't believe, will stand for that. So I'm pleased that the Council is represented here today to add their assessment to the record.

The process established by Congress in the Nuclear Waste Policy Act dictated that the U.S. Nuclear Regulatory Commission would ultimately be responsible for the licensing of the Nation's waste repository. We expected that the NRC would be wholly independent and autonomous on this issue. It is essential that the NRC remain unbiased in the development of the criteria for the evaluation of any application for the disposal of high-level radioactive waste.

Last month, a forum was sponsored by the National Research Council to examine the problems related to the licensing of the high-level waste repository. At that forum, a commissioner of the Nuclear Regulatory Commission stated that we ought to shift from traditional analytical methods and provide the Department of Energy greater freedom to juggle numbers. I was pleased when the U.S. Environmental Protection Agency rejected, out of hand, the suggestion, but extremely disappointed that such remarks were attributed to a commissioner of the Nuclear Regulatory Commission.

Standards are set to provide for the public health and safety. We don't compromise on health and safety by juggling numbers. If this is common practice in the nuclear industry, perhaps we should look into it further. Public health and safety cannot be compromised. That's not a debatable question.

The decision regarding the siting of the high-level waste repository will have ramifications for a period that is 50 times longer than our Nation has been in existence. The decision on a high-level nuclear waste repository would be with us for more than 500 generations. This is longer than recorded history and longer than any man-made structure has survived. In the rush to repair the weak link in the nuclear fuel site—a problem that has been with us for little more than a single generation—the solution must be one that the public of our entire Nation can live and stay alive with.

We need to resolve this nagging problem correctly. There cannot be a quick fix to the problem. We cannot resolve this by trial and error. We must be right the first time around. We have adequate storage space for spent fuel for more than a generation to come. We must start out fresh in search of the optimal solution for deal-

ing with high-level waste. Who, over the next 500 generations, can disagree with us?

By comparison, the nuclear power industry is a fledgling industry in America. We don't even have a total of 10,000 years of operating experience with all of our reactors put together. It has taken thousands of years of experience to acquire the basis to make the changes in the regulatory framework that was discussed at last month's hearing with the NRC. The nuclear power industry must move in a cautious fashion. The high-level waste repository would be expected to survive 10,000 years without due risk to the public.

As I stated before, whatever we do, it must be done right the first time. With zero experience in this area, we cannot begin this process by juggling numbers, changing time tested assessment methods, and making safety compromises. We look to the Nuclear Regulatory Commission and the Environmental Protection Agency to remain autonomous in this process. If we cannot trust these agencies, then who can we trust?

Thank you, Mr. Chairman.

Senator GRAHAM. Thank you very much, Senator.

We've been joined by the ranking minority member of our Subcommittee, and a person who has spent a considerable amount of his distinguished senatorial career addressing this subject, Senator Alan Simpson of Wyoming.

#### OPENING STATEMENT OF HON. ALAN K. SIMPSON, U.S. SENATOR FROM THE STATE OF WYOMING

Senator SIMPSON. Mr. Chairman, I thank you. You are a busy guy this morning. That was a good session on the U.S./Mexico trade agreements at 8:00. We have problems there and there's lots to do.

I can't think of anything more anguishing than being a Senator from a State that is impacted like this, to be in here doing what our colleagues are doing, with the same energy, gusto, and spirit as Senators Reid and Bryan. It would be a tough, tough thing. It must make you bridled. I'm sure that the citizens of that good western State feel the same. That is easy to say, when none of us are impacted like you are.

But this is the third hearing, now, on nuclear energy, and I think the most important. I think it's a fine time table that you've set for yourself, Mr. Chairman, and I admire your energy and perseverance. There is no one that can argue that across the whole spectrum of nuclear interests—the the extremists on both sides that drive things in this community—we at least all agree that there has to be a solution to the disposal of spent nuclear fuel and high-level waste, and it has to be done in a way that protects the public health and safety as well as protect the environment. We know that. I appreciate your leadership.

We have continually dealt with these issues, made some progress, and still have an awful lot of work to do. I commend your efforts to get this very important work done and to see that the country provides for permanent disposal.

We have 112 nuclear plants operating in this country right now. It's not some dream or some vision. They are out there right now

cranking it out, providing about 20 percent of the country's needed electricity. We have 20,000 metric tons of spent fuel, right now, at the end of 1989, projected to produce a total of 36,300 metric tons by the year 1998 when the DOE is supposed to take title of the spent fuel under the law. By the year 2010, when the repository is scheduled to be open to receive this fuel, there is going to be a total of 60,000 metric tons that have been generated.

Everywhere we go we see the signs and the protestors, "not here," "protect the public health and safety", and how the hell is the public health and safety protected when this stuff is sitting out there under demineralized water and we're reracking the pools and we're doing all the things that we do? Is that really, honestly, protecting the public health and safety? That is a stupid, stupid argument.

So as utilities wait for the repository, they continue to store this spent nuclear fuel on-site, right there, within 37 miles of some of the biggest populated areas in the country—40 miles, 50 miles. These pools are full to capacity, or close to it. As I said, they've done re-racking—they've done everything they could because the Congress—it isn't the Administration, it's the Congress. You can't blame this one on George Bush and you can't blame it on the NRC. It's Congress. That's who you blame it on.

I've been through all this. Gary Hart and I battered our brains out on this issue. So I've been here. I'm not jaded or cynical, but I'm sure a skeptic.

We're at capacity, or already full, reracking, done everything they can, and now the utilities have to find other ways to deal with spent fuel. How is that helpful to the public health and safety? They're trying to use dry cask storage. Some of these utilities will use up available on-site space before the repository is ready to accept the fuel without question. How is that good for the public health and safety?

Clearly, we are here with this anguishing situation which is so terrible for our two Senate colleagues from Nevada, but I think the effort to characterize the Yucca Mountain site must move ahead. And now that the 9th Circuit Court of Appeals has ruled in favor of DOE, the necessary environmental permits needed to commence surface and underground testing should be issued by the State. I'm sure that they will continue to resist. That is a typical western attitude. [Laughter.]

And it would be one that I would use with as much vigor as my colleagues.

But in the July, 1990 report "Rethinking High-Level Radioactive Waste Disposal" by the Board of Radioactive Waste Management, the Board stated—and I think Harry quoted some of it—

There is a world-wide scientific consensus that deep geologic disposal, the approach being followed in the United States, is the best option for disposing of high-level radioactive waste. There is no scientific or technical reason to think that a satisfactory geologic repository cannot be built.

That's all I ever found in my work as Chairman of this Subcommittee and as ranking member.

Then, a lot is being made over this sentence which follows the one that I just quoted. The following sentence states, "The U.S. program, as conceived and implemented over the past decade, is

unlikely to succeed." That sentence should not be taken out of context or judged to stand alone, because then the Board takes 30 pages to explain what they mean by that statement—30 pages.

The Board recommends that the EPA should consider using only dose requirements in setting regulatory standards, that the NRC should reconsider detailed licensing requirements for the repository, and that DOE should continue its efforts to participate in these regulatory issues and should make greater use of conservative engineering design. The Board does not say that we should abandon the possibility of characterizing the Yucca Mountain site. It does not say that.

So there we are. I've always had some deep feelings about the EPA in this situation. EPA has a glandular reaction to anything with the word "nuclear" in it. [Laughter.]

Anything, even to the absurdity of radionuclides, which are used in nuclear medicine, and nearly cratered that operation where we couldn't even operate those facilities because of the absurdity of that dual regulation.

I think the EPA is a remarkable agency and they do beautiful work, but they do miserable work when they are messing around with the work of the NRC. That is the agency that is asked to address the protection of the human health and safety in this issue, in this situation, and not the EPA.

If the Europeans can dispose of nuclear waste in an environmentally safe way which protects the public health and safety—we've been there, we've looked at it—we can, too. We must be about our business. There is no other way, if you really are intent upon protecting the public health and safety, that is.

Thank you.

Senator GRAHAM. Thank you, Senator.

We've been joined by Senator Richard Bryan, former Governor of the State of Nevada.

Senator.

#### STATEMENT OF HON. RICHARD BRYAN, U.S. SENATOR FROM THE STATE OF NEVADA

Senator BRYAN. Thank you very much, Mr. Chairman.

I'd like to ask a unanimous consent of the Subcommittee to include the full text of my remarks. I'll try to abbreviate in the interest of time.

Senator GRAHAM. Without objection, your prepared statement will appear in the record.

Senator BRYAN. Mr. Chairman, members of the Subcommittee, distinguished panel of witnesses, and ladies and gentlemen, I believe that any program charged with the responsibility of such a vexing nature must be both fair and must be one that is recognized as having integrity. The present program fails on both counts.

Justice Oliver Wendell Holmes, distinguished member of the Supreme Court for nearly 30 years, once observed that a page of history is often more instructive than a volume of logic, I believe that the 1982 Nuclear Waste Policy Act, in its inception, tried to provide both integrity and fairness. It was balanced regionally, premised upon the notion that no part of the country would have to



bear the entire burden of the Nation's nuclear waste. It provided a mechanism which contemplated involvement on parts of the States to participate in the site characterization process. It also recognized that, in the context of the Federal/State relationships, the States were at a decided disadvantage in terms of having the financial resources to conduct the kind of science that all would expect to be undertaken before any critical decision was made.

No sooner had President Reagan signed that piece of legislation in January of 1983, than the notion of fairness and equity was, in my view, irrevocably shattered. Several States were involved at that time, not just Nevada. In the State of Washington the Hanford site was being discussed. In the State of Texas the Deaf Smith County site was being discussed.

As the States applied for the financial resource which the act contemplated, the Department of Energy steadfastly refused to make that financial assistance available. Law suits were filed on behalf of the three States involved. The States prevailed in the United States District Court.

The Department of Energy continued to refuse to provide that assistance. Ultimately, appeals were taken to the 9th Circuit and that decision reaffirmed that the States were entitled to those resources. Finally, it took testimony before Congress to release the funds that were necessary.

Similarly, in terms of meaningful State participation in the process of the site characterization, that, too, was essentially rejected.

My colleague from Nevada has mentioned the enormous technical expectation that this concept involves, designing something for 10,000 years. Never in the history of civilization have we ever designed anything to last for that period of time. So when the citizens of my own State, as my good friend and the senior Senator from Wyoming points out, are concerned about public health and safety—he speaks to something that strikes right at the core.

Professor Gerald Jacob, in a book that was just released this year entitled "Site Unseen", describes an incident that occurred in Idaho in January of 1961 where a nuclear accident occurred. If the Chairman would be so kind as to allow me just a couple of minutes to read just a part of that, I think it underscores the gravity of concern. For us, it's not just a discussion of the esoteric nuances of science, it's a real concern that affects very deeply, and very personally, every citizen in my State.

We find in this incident that it describes three men who were working on the downed reactor—there was a problem with the reactor—manually reengaging its control rods. When the reactor went critical there was a steam explosion. Two operators were killed instantly. A control rod blown out of the pile speared one man through the groin and pinned his body to the roof.

Those parts of the corpses that had been covered by clothing were buried in lead coffins and placed inside lead-lined vaults. But parts of the bodies directly exposed to radioactive materials—the heads and the hands—had to be amputated and stored, awaiting final burial for the Nation's high-level radioactive waste. The reason for that was because the hands and the body parts directly exposed had themselves, Mr. Chairman, become high-level nuclear

waste. So we're not just talking about something that can be easily disposed of.<sup>1</sup>

I join my distinguished senior colleague in telling you that I think the process is fatally flawed. It does not lack public confidence. It does not lack credibility. And I will not belabor the time of this Subcommittee or the distinguished witnesses who appear here today to recite the litany of failures and the fact that to date more than \$2 billion have been expended on this project and we still continue to have those kinds of problems.

From the Lyons, Kansas site, which was unveiled with great fanfare—that was going to be the solution to the problem. As the members of this Subcommittee know, that was abandoned in 1972 when at the last minute it was discovered that because there had been extensive drilling for oil in that part of the Country, that indeed the caverns where this high-level nuclear waste was disposed were indeed compromised and punctured in many different places—to the most recent problems that we have.

I would simply say that the process itself and the approach that we take needs to be rethought, Mr. Chairman. I would conclude by asking, again, the Committee's indulgence to incorporate as part of the record an article that appeared in a newspaper by Jack Anderson and Dale Van Atta, another article by Jack Anderson and Dale Van Atta, and a copy of the Seattle Post editorial dated July 22nd.

I thank you, Mr. Chairman.

Senator GRAHAM. Without objection, each of these will appear in the record.

[Senator Bryan's prepared statement with attachments and additional questions and answers relative to a 1961 accident referred to by Senator Bryan follow:]

STATEMENT OF HON. RICHARD BRYAN, U.S. SENATOR FROM THE STATE OF NEVADA

Mr. Chairman, I thank you for this opportunity to comment on the Department of Energy's plan to evaluate Yucca Mountain for the Nation's high level nuclear waste repository, and in broader terms, on our history of nuclear waste management in general.

When President Reagan signed the Nuclear Waste Policy Act on January 7, 1983, less than a week after I became Nevada's Governor, our Nation embarked on a costly scheme to resolve a vexing technological problem—how to manage for hundreds of thousands of years the most toxic and harmful waste products that man has ever created.

The premise of the 1982 Nuclear Waste Policy Act was to evaluate a variety of sites and different geological formations so that the best solution to the high level commercial radioactive waste disposal problem could be found.

That act also contemplated a regional balance so that no single area of the nation would be unfairly burdened with the entire nation's commercially generated radioactive waste.

In the Nuclear Waste Policy Amendments Act of 1987, signed by President Reagan on December 22, 1987, a political decision was made to abandon the premise of the 1982 act and to shift the national policy from a balanced, scientific approach to targeting only one site—Yucca Mountain, Nevada—for further consideration for a repository location. This ill-conceived policy—abandoning science for politics when trying to solve a great scientific problem—was tangible evidence of the undue influence the commercial nuclear utility industry has had on the repository program since its inception.

The DOE and nuclear industry policy makers, however, have consistently underestimated the resolve of Nevada's citizens to oppose this flawed proposal. Even more

<sup>1</sup> See additional questions and answers relative to this accident at p. 14.

fundamentally, they were blind to the merits of the State's technical arguments that Yucca Mountain was a poor choice to even study for a repository.

I have said many times the national policy we are following is destined to fail. If, as Nevada's scientists and others strongly believe, Yucca Mountain is ultimately proven to be unsuitable for storing radioactive waste, more billions of dollars will have been wasted, and the nation will face an environmental crisis of epic proportions after the turn of the century without even so much as a contingency plan.

On July 18, 1989, I called upon the Secretary of Energy to use his existing legal authority to abandon Yucca Mountain, adopt a proven and cost effective interim storage program, and return this flawed plan for ultimate geologic or other storage options to a scientifically sound program. Governor Miller, on November 14, 1989 outlined in detail the state's scientific arguments and again asked the Secretary to use his authority to abandon consideration of Yucca Mountain.

As I have pointed out at every opportunity, all the existing program has succeeded in doing is to waste over two billion dollars of utility ratepayer's money. And unfortunately, like other federal government failures of recent years, the price tag on the repository grows each time the plan is revised and each time its cost is estimated.

We must remember that the original 1982 act and 1998 repository date opening were a reaction to a perceived fuel storage crisis. Now, with the twelve or more year delay in the repository, utilities are managing their waste storage needs in anticipation of the fact that no repository will be available to solve their immediate problem. A few reactors have already exceeded their spent fuel storage pool capacity, even after installing more compact storage racks (reracking). A growing number of utilities are purchasing and planning on using NRC licensed dry cask storage units at reactor sites to meet their interim storage needs.

The Nuclear Regulatory Commission has issued a revision of its "waste confidence rule" which indicates that at-reactor spent fuel storage can be safely and effectively implemented for a period up to 100 years. Thus the crisis that prompted the 1982 act and its deadlines DOE was unable to meet has now vanished with better technological approaches gaining acceptance.

When this issue first was raised in 1983, I based my opposition to nuclear waste storage at Yucca Mountain on the fact that Nevada had done its share and more for our country's nuclear efforts. Since we produced no high-level waste, it seemed inequitable and unreasonable to ship the waste products of other state's commercial nuclear power generation across the entire country to be stored for thousands of years in Nevada.

Not just Nevada was threatened by that prospect, but the transportation of lethal wastes generated mainly east of the Mississippi, across thousands of miles of our roads and highways, through hundreds of communities, threatened millions of Americans. It simply made nonsense then, nor does it make sense now. The risks are too great.

The story has changed dramatically after six years of scientific study by the state. As our technical knowledge increases, our initial concerns about the suitability of the Yucca Mountain site are being confirmed.

The geology, hydrology, volcanism and mineral potential at the site all indicate it is unable to isolate these lethal wastes from the environment for the tens of thousands of years it will take for them to decay to less dangerous levels of radioactivity.

The entire course of the Nation's nuclear waste effort has resulted in more than two decades of failures and false starts and apparently 1990 sadly will not be the end of this continuing saga of waste and failure.

While DOE blindly ignores expert opinion and the facts which continue to mount against Yucca Mountain, the United States taxpayers and utility ratepayers are footing the bill for DOE's follies. Since the passage of the NWPA in 1982, nearly three billion dollars have been wasted with no tangible progress evident for solving a very serious problem. Utility ratepayers are paying over a million dollars a day that DOE treats as its own largess.

I believe the time for a new institutional approach to this problem has arrived. I have introduced legislation, S. 2258, which will allow cost effective interim storage to be financed without burdening the utility ratepayers unnecessarily. With the pressure thus removed from the time-driven repository schedule, the institutional and scientific integrity needed to restore public confidence in nuclear waste disposal can be developed.

JACK ANDERSON and DALE VAN ATTA

## Nevada: Shaky Site for a Nuclear Dump

It's a hot potato, the proverbial ticking time bomb. America's nuclear waste needs a safe resting place, and soon. The government has spent years searching for the perfect spot, a location that some esteemed scientists now say could be a catastrophic mistake.

Yucca Mountain in the Nevada desert is the main site under consideration to hold spent nuclear fuel for at least the next 10,000 years.

Nevada became the reluctant target owing as much to political gyrations in Washington as practical considerations at Yucca Mountain. From the moment that the Energy Department picked Yucca Mountain in 1987, the most credible critic of the choice has been the department's chief geologist on the project.

Jerry Szymanski says he is neither a whistle-blower nor a political activist. He is just an Energy Department employee who is willing to say what others won't: Yucca Mountain is the wrong place.

It seems that groundwater under the mountain could flood the radioactive dump in the event of an earthquake, which his study says is highly likely in the next 10,000 years, barely a tick on the radioactive clock. If that happened, the water and earth would be poisoned.

Nevada's leadership, understandably opposed to turning their state into a nuclear dump site, got an early copy of Szymanski's study and made it public several years ago. Szymanski's bosses fired back with a propaganda blitz suggesting that his analysis was off-the-wall and solitary.

Szymanski didn't back down. When the final draft

of his study was finished last year, he insisted that it be reviewed by five scientific peers. That panel of geologists is winding up its review and the preliminary report is due out any day.

While the panel chairman declined to tell us which way the panel was leaning, one prominent member told our associate Dan Njegomir that it looks like Szymanski is right on the money.

"You've got a volcano staring you right there in the face," said panel member Charles Archambeau, an eminent geologist at the University of Colorado. "I've already decided they should start looking for another place."

Archambeau said he was reluctant to jump the gun and preempt other panel members. He also doesn't want his criticism to delay construction of the dump even longer. It's just that he wants it in the right place.

Why would the federal government be so blindly devoted to Yucca Mountain?

Szymanski offered one explanation—inertia. The bureaucracy gets sold on one notion and can't change course. He noted that two other sites under consideration earlier were also touted as ideal by their respective fans in the Energy Department.

The panel's findings won't be the last word on Yucca Mountain. Politics and yet other studies will see to that. But Archambeau said that if science alone is the judge, it won't take much to scratch Yucca Mountain off the list. The federal licensing requirement for the dump allows almost no possibility of any of the geological catastrophes that Szymanski says are likely. "If Szymanski is correct, it will kill the site," Archambeau said.



Jack Anderson and Dale Van Atta

## Stuck on Yucca Mountain

The Bush administration and Congress seem hell-bent on continuing an old American tradition—mishandling nuclear energy to the point where lack of public trust makes that energy option no option at all.

The latest bungling surrounds the ad nauseam process of choosing a national dump site for nuclear waste. To some key decision makers in Congress and the administration, Yucca Mountain in the Nevada desert is the most likely spot.

Never mind that the Energy Department's own chief geologist on the project has deemed the site unsafe. Never mind that another eminent geologist chosen to review that finding has corroborated it and agrees that an earthquake is highly likely on Yucca Mountain within the next 10,000 years—the government's working number for the life of the dump.

What is troubling in the shorter run is that the government doesn't have to bury its nuclear waste in an earthquake zone. Critics of the Yucca Mountain plan have been touting safer, cheaper options, and key policy makers are ignoring them.

As early as 1987, Congress voted

to make Yucca Mountain the only site to be studied for use as the nation's so-called repository of high-level waste. Nevada, of course, balked and has been battling the federal government in court. Registering their displeasure at being targeted for the dump, Nevada officials have denied even the permits needed to do exploratory drilling on the site.

Meanwhile, no one is satisfied with the sluggish progress in developing the dump, even as the chief geologist on the project, Jerry Szymanski, has raised questions that to any reasonable person would end consideration of the site immediately.

Sen. Richard Bryan (D-Nev.) was one of the first to take Szymanski's fears seriously, even when Szymanski's bosses at the Energy Department were dismissing them. Bryan has been pushing a bill in Congress to store waste temporarily in metal or concrete casks. It would let utilities store spent nuclear fuel rods at the sites where they were used in the first place, thus avoiding the need to haul the dangerous waste across country to Nevada.

Getting broad-based support for

any alternative will be a tough battle, given the government inertia behind the Yucca Mountain option. Not only has the bureaucracy grown used to the idea of permanent storage in Nevada but many in Congress who approved the idea are no doubt relieved that the dangerous cargo isn't coming to their state. Yet science is telling the government that Nevada is not the place.

The Energy Department's boss on the project, Carl Gertz, told us he isn't taking sides and will continue to collect data. He said he is still looking for a "show stopper"—scientific findings to signal thumbs down on Yucca Mountain. But, he said, that hasn't happened yet.

Pending such a show stopper, the government will continue studying Yucca Mountain. Those studies have already cost \$750 million and will likely cost \$3 billion more before a conclusion is drawn—a conclusion that Szymanski offered free three years ago. Gertz acknowledged that the study process will take years to complete.

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 July 22, 1990

# Seattle Post

The voice of the N

## Editorials

# U.S. should drop waste burial plan

**A**t last, scientists have admitted what any layman could have told them: It is impossible to build an underground repository for nuclear waste that can be guaranteed safe — as federal law requires — for 10,000 years.

This means we have to face two risky options: Bury it underground anyway and hope for the best, or keep the waste above ground — and hope for the best.

Simply put, it's a choice of whether we assume the risk ourselves, as seems only fitting, or assign it to our descendants, which seems immoral.

Few but the most deluded technocrats ever believed any structure could be built that would keep radioactive wastes from escaping into the human environment for 10,000 years.

But the Department of Energy has clung to the fiction that it could be done. To prove that, it has charged ahead with tests in a deep hole in the Nevada desert. However, the agency's efforts to demonstrate the safety of this disposal method have not gone well.

So now a National Academy of Sciences panel has issued a

report calling for a "rethinking" of the safety standards, recommending they be relaxed. Rightly enough, the scientists have concluded that present safety requirements are "unrealistic" and impossible to meet, especially since either volcanic or earthquake activity might wreck the repository and allow air or water to breach it.

The advantage of keeping this misbegotten waste above ground at such places as Hanford is that we can watch and control it. The disadvantage is that until new technology offers a better solution, the waste will have to be repackaged into uncontaminated containers every other generation or so for the next 250,000 years, which is how long some of the waste will remain deadly.

To be sure, continuing above-ground storage for this dangerous waste is not a cheery economic or political prospect.

But it seems preferable to stuffing it into a dump that — perhaps even before the protective packaging has crumbled away centuries hence — might turn into an uncontrollable nuclear hellhole.

11-30-90

MEMO TO: Karen Field  
Office of Senator Al Simpson, Wyoming

FROM: Nick Nichols, INEL Public Affairs Office, 208-526-1693

SUBJECT: Information about the 1961 SL-1 incident

Here are the questions and answers you requested 11-28-90.

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QUESTION: Did a nuclear reactor incident in Idaho nearly 30 years ago result in fatalities?

ANSWER: Yes. Stationary Low Power Reactor 1, a small experimental reactor being developed for the military, erupted at the National Reactor Testing Station in Idaho on January 3, 1961. Three men on duty that night were killed.

QUESTION: Was it a nuclear explosion?

ANSWER: No. Nuclear reactors, then and now, physically cannot explode like a bomb. The cause was an uncontrolled power surge from the reactor's core which suddenly released a large amount of heat to water coolant in the reactor vessel. The resulting steam-water expansion destroyed the reactor core and fatally injured the three military operators. This type of accident, in that one-of-a-kind experimental reactor, is highly unlikely to happen again because of vastly different control systems now in use.

QUESTION: Were other people injured and did contamination spread?

ANSWER: No other persons were injured. Radiation fields inside the reactor building were high, and some contamination spread outside in the immediate vicinity. The reactor building was not a sealed containment structure like those enclosing commercial power reactors in the United States, but it did entrap most of the harmful materials. Atmospheric discharges of extremely low levels of radioactive iodine were detected offsite for several days after the incident, but they did not pose a public health hazard.

QUESTION: What caused the steam explosion?

ANSWER: A September 24, 1962, U.S. Atomic Energy Commission report on the incident states: "The direct cause of the accident clearly appears to have been manual withdrawal by one or more of the maintenance crew of the central control rod blade from the SL-1 core considerably beyond the limit specified in the maintenance procedure ... There is insufficient evidence to establish the actual reason or motive for such abnormal withdrawal." The report lists "human error" or "malperformance motivated by emotional stress" as possible factors.

QUESTION: Were the victims' bodies contaminated with radioactive material?

ANSWER: Yes. Their remains required special burial techniques to insulate them from the environment.

QUESTION: Why is this incident notable?

ANSWER: Because it is the only fatal nuclear reactor accident in the United States since Enrico Fermi built the first reactor in Chicago during World War II, nearly 50 years ago. By contrast, about 60,000 Americans die violently every year in auto accidents. Many thousands more are disfigured and crippled. Driving, however, is considered an acceptable risk in view of benefits gained. Despite its critics, America's nuclear power industry provides very safe places in which to work. The benefits produced, in this era of fossil fuel dependence, far outweigh the risks.

Senator GRAHAM. Thank you, Senator.

Our first panelist today is Doctor Robert Bernero, Director, Office of Nuclear Materials Safety and Safeguards of the Nuclear Regulatory Commission.

**STATEMENT OF ROBERT BERNERO, DIRECTOR, OFFICE OF NUCLEAR MATERIALS SAFETY AND SAFEGUARDS, NUCLEAR REGULATORY COMMISSION**

Mr. BERNERO. Good morning, Mr. Chairman.

I have filed testimony for the record and will provide now only a very brief oral summary of it.

In our view, the status of the High-Level Waste Program is slow or stopped at this time. Site characterization is stopped by the opposition of the State of Nevada and by the Department of Energy's need to remedy flaws in the site characterization plan before proceeding. Meanwhile, the Environmental Protection Agency and the NRC are reviewing and revising regulations for high-level waste disposal.

In the summer of 1989, the NRC found that the Department of Energy had a usable site characterization plan, but we raised two objections and several major comments on the plan. The Department is now working to resolve these.

Regarding the EPA high-level waste standards, many have expressed concerns that either the form of the EPA standards or their stringency might prevent the NRC from reaching a licensing decision regarding an otherwise acceptable high-level waste repository. The NRC is continuing to work with the EPA to adjust the detailed probabilistic form and wording of the EPA standard to address concerns about demonstrating compliance in licensing evaluation.

As to the stringency of the standard, the NRC has asked the EPA to reexamine this and give a clear articulation of the risk basis for the standard. The Commission is reserving judgment on whether we believe the standard is overly stringent, pending EPA's response to our request and a thorough evaluation of the results of the recent National Academy of Science's symposium on September 17th and 18th.

One commissioner and the staff participated in the NAS symposium on radioactive waste repository licensing. The Commission has delayed consideration of the conclusions and recommendations in the Board's report pending actions to evaluate the views expressed at that meeting and our work on the EPA and NRC standards. The Commission will be happy to forward its views on the recommendations on the report when it has completed its deliberations.

Thank you.

Senator GRAHAM. Thank you very much, Doctor.

Doctor Michael Shapiro, Deputy Assistant Administrator for Air and Radiation of the EPA.

**STATEMENT OF MICHAEL SHAPIRO, DEPUTY ASSISTANT ADMINISTRATOR FOR AIR AND RADIATION, ENVIRONMENTAL PROTECTION AGENCY**

Mr. SHAPIRO. Thank you, Mr. Chairman, and members of the Subcommittee. I appreciate this opportunity to describe EPA's activities and views in the area of the disposal of spent nuclear fuel and high-level radioactive waste. I have also submitted my full testimony for the record and will be summarizing my remarks, primarily addressing the issue of the EPA's standards in this area.

As you know, the EPA promulgated its environmental standards for high-level waste in 1985 in two parts: Part A, limited exposure during management and storage of the subject waste; and Part B, addressed standards for post-disposal requirements. The Part A requirements are currently in effect. The Part B disposal requirements were vacated by the U.S. Court of Appeals and are being reconsidered by the EPA.

The Part B disposal requirements that were remanded to the agency had four components: long term containment requirements that limited projected radionuclide releases to the accessible environment for a period of 10,000 years; qualitative assurance requirements that provided additional confidence in the disposal provisions; requirements that limited individual exposures to members of the public for 1,000 years under undisturbed operations; and requirements that limited radionuclide concentrations in certain sources of ground water.

The Court's remand focused primarily on our ground water and individual exposure provisions. However, in revising the regulations, we are considering changes not only in these provisions, but in other parts of the regulation as well. In particular, as a result of the recommendations contained in the NAS report, as well as comments received by the Nuclear Regulatory Commission, the Department of Energy, and others, we will be considering changes in the containment provisions and focusing on possible alternatives to consider for proposal and public comment.

Our most recent schedule anticipated proposing revised regulations in early 1991 and promulgating final regulations by mid-1992. We believe that, in light of the comments that we've received and the need for additional work, this schedule will have to be adjusted by several months at least.

With respect to the long-term containment standards, I think it is useful to discuss some aspects of the standards that were promulgated in 1985, noting, of course, that they are being reconsidered at present. First, the standard was based on EPA's analysis of the level of containment that could be projected from current technology and well-designed geologic high-level disposal waste repositories. Our modeling suggested that these containment standards would result in an expected level of less than 10 cancer deaths for 1,000 tons of spent fuel waste over a 10,000 year period.

Our analyses also concluded that this level of risk was within the range of risks that would be experienced over the same time period from uranium ore needed to manufacture a similar quantity of fuel—in other words, from naturally occurring sources of uranium, assuming that that ore was never mined.



Our standards also took into account the considerable uncertainty associated with projecting over this time scale and did not call for absolute certainty in demonstrating compliance with the standards. Rather, the standards anticipated the need for expert judgment to be applied by the NRC and DOE during the licensing process.

In summary, we believe that it's possible to develop a regulatory framework for high-level waste that is protective of human health and would permit the development of well-engineered disposal facilities. We believe that our 1985 standards represented a suitable approach toward that end, but will consider improvements and alternative approaches as we work with the comments that we have received in our forthcoming rule-making.

Thank you.

Senator GRAHAM. Thank you, Doctor.

Doctor Don Deere, Chairman of the U.S. Nuclear Waste Technical Review Board.

#### STATEMENT OF DON U. DEERE, CHAIRMAN, UNITED STATES NUCLEAR WASTE TECHNICAL REVIEW BOARD

Dr. DEERE. Mr. Chairman, members of the Subcommittee, I'm Don U. Deere, Chairman of the Nuclear Waste Technical Review Board. The Board was established by Congress in 1987 and activated in 1989 to evaluate the technical and scientific validity of the DOE's program of high-level waste management. I wish to thank you for the opportunity to present the Board's current views.

In 1955, the National Academy of Sciences recommended permanent isolation of high-level waste in mined geological formations. This basic approach for disposal is still being pursued. There is currently a world-wide scientific consensus that a deep geologic repository is the best option for the disposal of high-level waste. The Board believes that there are no insurmountable technical reasons why an acceptable deep geologic repository cannot be developed.

The Board's testimony will focus on three topics: (1) technical aspects of maximizing the isolation of the waste; (2) regulatory improvements; and (3) nontechnical siting problems. I will conclude with some general comments on DOE's program.

The first point deals with maximizing the waste isolation. The proposed repository will consist of both natural geologic barriers and engineered barriers that together will contain the high-level waste for thousands of years. The overall confidence about a repository's long-term performance is enhanced by using redundant engineered barriers.

However, because of past ambiguities in the regulations, long-lived waste packages and other types of engineered barriers have not been considered to their maximum extent in current repository designs. Improved engineered barriers, designed for greater than 10,000 years, can, in our judgment, make a substantial contribution to waste isolation and increase our overall confidence in the ability of the repository to meet its goals. The Board has recommended that the DOE investigate further the advantages associated with the use of longer-lived engineered barriers.

Our second point deals with regulatory improvements. The regulatory framework should provide assurance that a repository will, in fact, isolate high-level waste. The Board believes the regulatory framework should be sufficiently conservative to fully protect public health and the environment. But it should not be so restrictive as to foreclose at the outset the use of repository sites that can be shown to be suitable on the basis of sound scientific and technical considerations.

However, many in the technical community are currently concerned about our ability to construct and license a repository in accordance with present Federal standards and regulations. Some guidelines have been criticized as being too stringent and prescriptive; others as too ambiguous or simply inappropriate for geologic repositories.

The Board detailed several concerns about the EPA Standard, 40 CFR 191, in its first report to the U.S. Congress and the U.S. Secretary of Energy. Many other groups have similar, and sometimes broader, concerns about our present regulatory framework.

We believe that the current regulatory framework can be improved. With such improvements, a candidate site, judged to be technically suitable, can also be licensed. In recent letters to William Reilly, the Administrator of EPA, and Kenneth Carr, the Chairman of the NRC, we have suggested that the EPA and the NRC enter jointly into negotiated rule-making on 40 CFR 191 and 10 CFR 60.

The third point deals with nontechnical siting problems. Early evaluation of the suitability of the Yucca Mountain site has been, and continues to be, a prime concern of the Board. However, the DOE's efforts to characterize the Yucca Mountain site are presently constrained by the State of Nevada's refusal to issue the necessary State permits. Site characterization is an essential phase in determining the suitability of the candidate site for repository development. Any delays in site characterization will result in comparable delays in arriving at a judgment about the site's suitability.

Finally, I would like to make some general comments about the DOE's current program. The Board sees progress by the DOE in implementing its High-Level Waste Management Program. In November of 1989, the Secretary of Energy issued a comprehensive report to the Congress refocusing the program. The Board believes that the changes in programmatic schedules reflect a more realistic appraisal of the complexities of waste management activities.

In May, 1990, the newly appointed Director, Doctor John Bartlett, announced the development of a new management plan. In June, David Leroy was appointed Nuclear Waste Negotiator to facilitate the siting of facilities for interim storage and/or permanent disposal of high-level waste. These we consider as positive steps.

We are pleased with the DOE's good faith efforts to address the recommendations that the Board made in its first report. This is particularly the case with respect to the need for additional underground exploration, that is, by more extensive exploratory shafts and tunnels—which we consider the very best way to reduce site uncertainties about the geology—and the prioritization of testing for early determination of site suitability, plus the iterative use of

performance assessment at every stage of these studies. As the DOE program progresses, the Board will continue to fulfill its mandate responsibilities of monitoring ongoing DOE activities and reporting its findings and recommendations to the Congress.

Our second report to Congress and to the Secretary of Energy, will be issued next month.

Mr. Chairman, that concludes my prepared remarks. We have tried to address the general thrust of the questions in your letter of invitation to testify. I would be pleased to address any other questions you may have right now.

Senator GRAHAM. Thank you, Doctor Deere.

We now have Mr. Charles Fairhurst, Vice Chairman, Board on Radioactive Waste Management of the National Research Council.

#### STATEMENT OF CHARLES FAIRHURST, VICE CHAIRMAN, BOARD ON RADIOACTIVE WASTE MANAGEMENT, NATIONAL RESEARCH COUNCIL

Mr. FAIRHURST. Senator Graham, distinguished members of the Subcommittee, I am Charles Fairhurst, Vice Chairman of the Board on Radioactive Waste Management of the National Research Council. It is an honor to be invited to speak to you today.

I'm going to briefly outline, as requested, the Board's report "Rethinking High-Level Radioactive Waste Disposal." A complete report has been submitted for the written record, so I will just confine my remarks to a very brief summary of the main context.

The U.S. program on geologic disposal of high-level waste is one of many such programs world-wide, as has been said several times already. All of these programs have opted for geologic disposal. However, the U.S. program is unique among those of all other nations in its rigid schedule, its insistence on defining, in advance, the technical requirements for every part of the multi-barrier system, and in its major emphasis on the geological component of the barrier as detailed in 10 CFR 60. Because one is predicting the fate of the high-level waste into the distant future, the undertaking is necessarily full of uncertainties.

The current U.S. approach does have several advantages. It facilitates rigorous oversight and technical auditing; its goals and standards are clear; it is designed to create a sense of confidence in the planning and operation of the repository; and, if carried out according to specifications, it is robust in the face of administrative or legal challenge.

However, this approach, the Board believes, is poorly matched to the technical task at hand. It assumes that the properties and behavior of a geologic repository for thousands of years into the future can be determined and specified with a very high degree of certainty. In reality, however, the inherent variability of the geological environment will necessitate frequent changes in the specifications, with resultant delays, frustration, and loss of public confidence. The current program, in our view, is not sufficiently flexible or exploratory to accommodate such changes.

The United States appears to be the only country to have taken the approach of writing detailed regulations before all of the data are in. As a result, the U.S. program is bound by requirements that



may be impossible to meet. The Board believes, however, that enough has been learned to formulate an approach that can succeed.

This alternative approach emphasizes flexibility, time to assess performance, a willingness to respond to problems as they are found, remediation if things do not turn out as planned, and revision of the design and regulations if they are found to impede progress toward the health goal already defined as safe disposal.

I wish to add parenthetically here that the Board has not recommended a change in the ultimate health standards.

To succeed, however, this alternative approach will require significant changes in laws and regulations, as well as in program management.

In conclusion, the Board has seven recommendations. First, the Congress should reconsider the schedule in the Nuclear Waste Policy Act and the 1987 amendments. The Secretary of Energy's recent announcement of a repository opening delay to 2010 rather than 2003 is a welcome step in this direction.

Second, the EPA should reconsider the detailed performance standards in 40 CFR 191 and the U.S. Nuclear Regulatory Commission should reconsider the detailed licensing requirements of 10 CFR 60.

The DOE should expand its current efforts to become a more responsive player in these regulatory issues. They should have, for example: publicly negotiated pre-licensing agreements with the U.S. Nuclear Regulatory Commission on how to deal with high uncertainties; on how to develop improved strategies for overall performance assessment; and active negotiations with the EPA and the U.S. Nuclear Regulatory Commission on real goals and precise definitions of their standards and requirements.

We suggested also that there be an extramural grant program, in cooperation with the National Science Foundation, for the development of improved modeling methodology, so that all of the Nation's scientists can be asked to participate in this task; expanded use of expert scientists from outside the program to review and critique the program; a greatly expanded risk communication efforts in communicating these risks to the U.S. public; and meaningful dialogue with State and local governments, Indian tribes, environmental public interest groups, and other interested organizations.

We believe, fifth, that the Department of Energy should make greater use of conservative engineering design instead of unproven design based on untested scientific principles. Also, the DOE should be more active in international programs and subject its plans to international review.

Finally, although geologic disposal has been the national policy for many years, and the Board believes it to be feasible, contingency planning for other sites and options, e.g., Subseabed Disposal, should be pursued in the event that some issue should make it impossible to license the geologic repository.

Thank you, Mr. Chairman.

Senator GRAHAM. Thank you very much, Doctor Fairhurst.

Doctor Robert R. Loux, Executive Director of the Nuclear Waste Project Office for the State of Nevada.

**STATEMENT OF ROBERT R. LOUX, EXECUTIVE DIRECTOR,  
NUCLEAR WASTE PROJECT OFFICE, STATE OF NEVADA**

Mr. Loux. Thank you Mr. Chairman, and members of the Subcommittee. The State of Nevada certainly appreciates the opportunity to be here today to express our views. As you know, we have submitted a detailed written statement for the record. I think it's important for us to be here for us to put the current nuclear waste program in, what Nevada believes to be, an accurate perspective.

As many have alluded to today, there is a stalemate over the Yucca Mountain issue between the Federal Government and the State of Nevada. That stalemate has to do with the Nuclear Waste Policy Act and its amendments, and the DOE's compliance with that act, as well as DOE's compliance with its own statutorily required site suitability guidelines. It has little or nothing to do with the nature of licensing standards or regulations of the EPA and the NRC.

The issue is whether DOE's priority should be screening the existing geologic characteristics of the candidate site, Yucca Mountain, against the specific technical qualifying and disqualifying conditions of its site suitability guidelines as we maintain the law requires.

In summarizing my written statement, I'd like to make a couple of summary points, one about DOE's approach to characterization, the other about the NAS paper on "Rethinking High-Level Waste Disposal".

First, regarding DOE's approach to site characterization, the Nuclear Waste Policy Act has structured a repository program so that two distinct decisions must be made. The Secretary of Energy must determine the suitability of a site, and the NRC must determine the licensability of a site found to be suitable by the Secretary. The standards for the two decisions are entirely different.

The Secretary's decision regarding suitability is to be based on the siting guidelines he's required to establish through the act which must include factors which qualify and disqualify a site. These are essentially site screening criteria intended to remove a site from further consideration if it has existing geologic characteristics that result in obvious unacceptable uncertainties or risk to waste isolation.

The Commission's decision is one of whether the applicant has demonstrated reasonable assurance that a repository's overall waste isolation performance will meet the health and safety standards laid down in the rules of the NRC and the EPA. Performance assessment, not the evaluation of individual site characteristics, is a tool intended to provide the final demonstration.

The presumption in the NRC's license application review that the site has already passed the Secretary's rigorous suitability screen based on its geologic characteristics. However, the DOE has devised a site characterization program that ignores the Secretary's disqualification criteria and instead focuses on developing the more difficult and resource consuming performance assessments needed for compliance with the licensing standards and the rules of the NRC and the EPA. This site characterization approach in stepping around the Nuclear Waste Policy Act's suitability



screening requirement violates the presumption of the NRC's licensability review regarding the prior screening of the site.

Mr. Chairman, since 1983, the Secretary has spent over \$1 billion at the Yucca Mountain site and at least another \$2 billion is projected to be spent over the next seven to ten years in carrying out the DOE's elaborate site characterization plan. According to the plan, the Secretary will announce whether he believes a site is licensable when the three billionth dollar is spent.

But what if the site has not passed the initial test and is determined not suitable first? Nowhere in the plan, before the very end of site characterization, does the Secretary evaluate the site's geologic characteristics against technical disqualifying conditions of the site suitability guidelines. The DOE has stated that it has no plan or methodology to do so.

Both Nevada and the nuclear utilities have faulted the DOE's plans for their lack of early and ongoing suitability determination during site characterization, although we do disagree on how we think it should be done. The reason is simple: accountability and fiscal responsibility. If the site is not suitable or licensable, it is in everyone's interest to know as soon as possible.

My second point, regarding the NAS position paper, is closely related to the same issue. As I mentioned earlier, the Yucca Mountain stalemate is not a licensing problem. Instead, it is a site screening problem. We have not reached the point at Yucca Mountain where licensability is the foremost issue except that the DOE has incorrectly made the Secretary's suitability determination synonymous with licensability.

The NAS position paper, I think, makes the same mistake, then it sets out to assert that there is something fundamentally wrong with the generic licensing rules of the NRC and the EPA. The flaw, according to the paper, not only makes Yucca Mountain likely unlicensable, but probably makes any site likely unlicensable.

We agree about Yucca Mountain, not because of any flawed regulations, but because of the strongly adverse site conditions and enormous geologic uncertainties which, together, make performance assessments very difficult and probably unconvincing.

We don't necessarily agree with the NAS paper's conclusion about any site. There has not been a meaningful test involving sites that do not exhibit the types or levels of complexities and uncertainties that are already known at Yucca Mountain.

Rather than recognizing that the current problem is the site and not the licensing rules, the NAS paper proposes to totally revamp the regulatory approach to repository licensing. As a means, to gain what was referred to as greater flexibility, the paper proposes a two-pronged regulatory approach that represents a large departure from our existing philosophy of independent objective regulatory oversight.

First, it proposes that the standards of acceptable performance be developed based on the projected performance capability of the repository as built. This is essentially advocating setting the standards to fit the product. It also suggests that the real regulatory directive should be "Do the best you can and that will be all right."

Secondly, and equally divergent from current policy, is the proposal that the regulator, the NRC, participate with the applicant,

the DOE, in an ongoing process for performance-enhancing design modifications during a combined period of site study and repository construction prior to the NRC license review.

The expected outcome of this after-the-fact standard setting and participation role of the regulator is obvious. No amount of public confidence building, as the Board suggests should be done through the mechanisms of compensation, negotiation, and persuasion, will overcome a massive alteration of the regulatory process.

In conclusion, Mr. Chairman, let me say that the Nuclear Waste Policy Act provides a vehicle to allow the DOE, the Congress, and all other interested parties to examine the Nation's nuclear waste policy and program designs and to focus a dialogue, should the Congress so choose, on the DOE's restructured plans for its overall program implementation, including resolving the anticipated problems.

That vehicle is the mission plan which is required in Section 301 of the Nuclear Waste Policy Act. While the DOE issued a mission plan and amendments for the 1982 act, it has yet to inform the Congress, through this vehicle, of its plan for implementing the 1987 Nuclear Waste Policy Act amendments.

Both Secretary Watkins and Director John Bartlett are committed to more fully describing the Secretary's recently restructured waste program in a mission plan revision. This should be done openly and reviewed by Congress and other parties before DOE proceeds further in the waste program, which is now going forward at great risk, at least in part due to DOE's own design.

Thank you, Mr. Chairman.

Senator GRAHAM. Thank you, sir.

Mr. Allen Keesler, President and CEO of the Florida Power Corporation.

**STATEMENT OF ALLEN J. KEESLER, JR., PRESIDENT AND CEO,  
FLORIDA POWER CORPORATION**

Mr. KEESLER. Thank you.

Mr. Chairman, distinguished Senators, my name is Allen J. Keesler, Junior, President and CEO, Florida Power Corporation in St. Petersburg, Florida, and Chairman of ACCORD. Today I am here to testify for ACCORD, ANEC, EEI, and EEI/UWASTE.

With the events of the past few weeks in the Middle East, and with the pending acid rain legislation, our Country's continuing concern with the greenhouse gases and their effects, and with this Nation's desire to compete competitively in a global environment, I believe it is apparent that we must maintain our nuclear option. The electric industry is in no position to move forward until a satisfactory resolution is found for the permanent disposal for spent fuel.

In 1982, the Congress mandated that the DOE should start accepting spent fuel in 1998. To fund this effort, Congress mandated ratepayers to pay a one mill per kilowatt hour fee for the disposal of spent fuel. Through June of 1990, the ratepayers of this Country have paid more than \$4 billion and are currently paying at a rate of \$500 million a year. The citizens of Florida, Mr. Chairman, have paid \$311 million and are paying at a rate of \$23 million per year.

DOE's latest estimates show the earliest that the permanent MRS repository can start accepting spent fuel is in the year 2010. In the interim, it is imperative that an MRS site be located, sited, and opened, so that spent fuel can be received by 1998. For this to happen, Congress must de-link the MRS from the repository.

For the permanent repository to become a reality, access to the Yucca Mountain site is imperative. Both sides of this issue have made claims and counterclaims about the suitability of the mountain as a permanent repository for spent fuel. The truth is, neither side will know until access is gained and characterization begins. I strongly urge the State of Nevada and the DOE to work closely together and allow the characterization process to begin. If this does not happen, Congress needs to act.

Senator GRAHAM. Thank you, Mr. Keesler.

Mr. Michael Wilson, Chairman of the Florida Public Service Commission.

Senator REID. This is the most important one.

Senator GRAHAM. We used a merit selection process. [Laughter.]

#### STATEMENT OF HON. MICHAEL WILSON, CHAIRMAN, FLORIDA PUBLIC SERVICE COMMISSION

Mr. WILSON. Thank you.

Good morning, Chairman Graham, distinguished Subcommittee members, and Senator Bryan. I am Michael Wilson. I am Chairman of the Florida Public Service Commission. I am also Chairman of the Subcommittee on Nuclear Issues Waste Disposal of the National Association of Regulatory Utility Commissioners, on whose behalf I appear today.

Public utility commissioners have had two major concerns with the Nuclear Waste Program since its inception: its financing and its management. The first major concern we have is the amount of money already paid into the Nuclear Waste Fund by the ratepayers—not utilities—for the purpose of establishing a permanent storage repository for spent nuclear fuel.

Through June 30, 1990, ratepayers in this Country are obligated for approximately \$6.9 billion for the DOE's Nuclear Waste Fund through a mandated fee of 1 mill per kilowatt hour generated by nuclear units. That figure could exceed \$7 billion at this point. Through June 30, 1990, the DOE has spent \$2.6 billion on the program and could spend \$30 billion to \$40 billion more in order to accomplish its charge to establish a permanent repository for the storage of spent nuclear fuel, or nuclear waste.

The public utility commissioners of this Country have a responsibility to the ratepayers of their States to insure that the program succeeds and that the enormous amount of money already collected and spent by DOE, as well as all future funding of the program, result in the successful completion of the repository.

The second major concern that we have had is the management of the program to date. From the beginning, the program has been plagued by frequent delays, which have, in turn, increased the costs of the program. We are so concerned with this program that the NARUC Subcommittee on Nuclear Issues and Waste Disposal created the NARUC Nuclear Waste Program Assessment Office

here in Washington, D.C. This office, which opened in July, 1990, is being funded by States which have nuclear generation and is being staffed by Ron Callen, who is on loan from the staff of the Michigan Public Service Commission.

We have been greatly encouraged by the actions taken by Energy Secretary James Watkins. Admiral Watkins has outlined a more realistic time table for the permanent repository, a restructuring of the management of the program, and the development of an integrated Monitored Retrievable Storage program for interim storage needs. Doctor John Bartlett has been selected as Director of the program and has begun its reorganization. Major changes, of which we certainly approve, are the direct reporting relationship between the Nevada operation and the Office of Civilian Radioactive Waste Management, and the appointment of David Leroy as Nuclear Waste Negotiator to facilitate the location of an MRS site.

Meeting the program's established goals is critical. Reactor sites will soon reach capacity limits for the storage of spent fuel. The NRC has concluded that a number of reactor sites, 67, will have reached spent fuel storage capacity limits by the year 2014, the approximate date that DOE is now projecting for the opening of a permanent repository.

In addition to the fees being collected from ratepayers, though, the ratepayers have also begun to pay for the construction of on-site storage facilities at nuclear reactor sites pending DOE acceptance of nuclear waste in 1998.

The recent decision in the case of Nevada versus DOE before the U.S. Court of Appeals, 9th Circuit, is a first step in resolving the problem of access to the Yucca Mountain site. With a program limited to characterizing a single geologic site, it is important to us and our ratepayers to determine as quickly as possible whether that site is suitable.

In your letter, you asked for responses to the NAS report. Although we are regulators, not scientists, we are not quite ready to deem the Nuclear Waste Program as "unlikely to succeed." First, it must be kept in mind, I think, that the NAS report is the result of a symposium that was held in 1988, a full year before Energy Secretary Watkins presented his report to Congress on reassessing the Nuclear Waste Program.

Second, we are concerned that, even at the most recent NAS symposium held last month, there is little emphasis on the timely resolution of the licensing controversy among the EPA, the NRC, and the DOE.

The NRC and the DOE are engaging in an ongoing discussion on licensing requirements, performance analysis, and quality assurance. We would urge this Committee and the Congress to inquire into the progress of these discussions to determine how far from resolution these issues are.

I think I can summarize the position of the NARUC in this issue. We have the waste, DOE has our money [laughter] we would like to close the deal.

DOE may keep our money, but they must take the waste.

We ask, for the sake of ratepayers who are funding this program, that this Subcommittee and the Congress use your oversight ability to ensure that this program moves ahead.



Thank you very much.

Senator GRAHAM. Thank you, Mr. Wilson.

Mr. John W. Bartlett, Director, Office of Civilian Radioactive Waste Management, Department of Energy.

**STATEMENT OF HON. JOHN W. BARTLETT, DIRECTOR, OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT, DEPARTMENT OF ENERGY**

Mr. BARTLETT. Thank you, Mr. Chairman.

With your indulgence, I'd like to take this opportunity to introduce my colleagues who are here with me today: Mr. Frank Peters, Deputy Director of the Office of Civilian Radioactive Waste Management; Mr. Carl Gertz, Associate Director for Geologic Disposal; and Mrs. Ginger King, Director of our Education and Information Division.

My formal statement makes three key points concerning the role of high-level waste management and nuclear power. What I'd like to do this morning is take this opportunity to briefly summarize them. But before I do, I'd like to emphasize, as you've heard previously from the Deputy Under Secretary for Policy and from the Assistant Secretary for Nuclear Energy, the Department believes that the nuclear option is of vital importance to our future energy supply.

The first point I would make is that high-level waste management is on everyone's list as a factor in the future availability of the nuclear option. There is not, however, consensus as to what constitutes success in removing waste management issues as obstacles to development of nuclear power. Whatever the signals for success are, I believe that partnership between the Department and the Congress, with support from affected and interested parties, is essential for progress and success.

The second point I would make is that under Admiral Watkins' leadership, the Department has made significant progress during the past year in actions to fulfill the high-level waste mission assigned to it by Congress. We have restructured the program, we've made significant improvements in management, and we have focused our plans and strategy for waste storage, transport, and disposal—and I might add—in ways responsive to the kinds of comments you've heard so far this morning from other people participating in this hearing.

In response to the 9th Circuit Court decision, which found that the State of Nevada's allegations as to the illegality of DOE's efforts to evaluate the Yucca Mountain site are without merit, yesterday we refiled the applications for the permits that we need to resume site evaluation activities. We will be fully ready to resume activities in January, 1991, and will do so if we have the permits.

The third and final point I would make here is that we will continue to focus the program and run it efficiently, and we would like to do so in a partnership with Congress to the benefit of nuclear power. There are several types of actions the Congress can take for this partnership. One is to assure that we have the money and people needed to maintain the Secretary's plan and schedule. In

that regard, the Congress might consider multi-year funding, as was done in Canada.

Another action Congress can take is to facilitate siting development and the use of the Monitored Retrievable Storage facility. An MRS facility is an essential part of the waste management system. The Nuclear Waste Negotiator is about to embark on the MRS siting effort, with strong support by the Department, as requested by him.

The Congress could encourage States to seriously consider opportunities to host the MRS facility, recognizing that it carries with it a package of activities and functions with significant socioeconomic benefits that can be negotiated.

Finally, Congress can, in general—and at every opportunity—assist the Department in exhibition of Federal resolve to eliminate high-level waste management as an obstacle to the future of nuclear power.

I thank you, Mr. Chairman, for this opportunity to participate in this hearing.

Senator GRAHAM. Thank you very much, Mr. Bartlett.

We have been joined by Senator Symms from Idaho.

Senator, do you have an opening statement?

#### OPENING STATEMENT OF HON. STEVE SYMMS, U.S. SENATOR FROM THE STATE OF IDAHO

Senator SYMMS. Mr. Chairman, I would ask unanimous consent that my opening statement be included in the record.

Senator GRAHAM. Without objection.

Senator SYMMS. And I would also like to introduce an interested guest that's here today. This man has recently given up his job with the Department of Energy's Office of General Counsel and has taken a job with my friend and fellow Idahoan, Dave Leroy. As many of you know, Mr. Leroy is the White House Nuclear Waste Management Negotiator and representing him today is Mr. Bob Mussler of the Washington, D.C. office.

Bob, are you out there somewhere?

There he is. It's nice to have you here. Thank you.

I'm sure he'd be interested in these hearings, and I'll submit my statement to the record.

Senator REID. What does he do, work with David?

Senator SYMMS. That's correct. He's his representative here, I understand. Maybe he wants to say what he does.

Mr. MUSSLER. I work at Mr. Leroy's office.

[Senator Symms' opening statement follows:]

#### OPENING STATEMENT OF HON. STEVE SYMMS, U.S. SENATOR FROM THE STATE OF IDAHO

Mr. Chairman, and Members of the Subcommittee, ladies and gentlemen, before I get too far into my remarks for today's hearing, I want to introduce a very interested guest. This man has recently given up his job with the Department of Energy's Office of Civilian Radioactive Waste Management and has taken a job with a friend and fellow Idahoan of mine, David LeRoy. As many of you may know, Mr. LeRoy is the White House Nuclear Waste Negotiator and representing him here today is Mr. Bob Mussler of his Washington, DC, office.

## BACKGROUND

The subject of today's hearing is very timely as we consider our energy dependence in light of the crisis in the Middle East. The decisions we make, or refuse to make, regarding development of a rational strategy for disposing of nuclear waste will greatly determine the role that nuclear power will play for our country in the future.

Nuclear power is a strategically important answer to our nation's energy security needs. This is not only because of the uncertainty of our oil supplies, but also because of the clean nature of the technology and how critical that is to future environmental concerns. In fact, I believe nuclear power can be a technological savior for successful management of our planet's resources.

Today's hearing focuses on the disposal of spent fuel and other high level waste from nuclear reactors. Although there is great promise on the horizon for improving safety at nuclear power plants, the specter of what we should do with this waste continues to haunt the nuclear option.

## IMPROVEMENTS IN SAFETY AND PLANT MANAGEMENT

The Nuclear Regulatory Commission has provided strong leadership in establishing a "safety first" approach to nuclear energy policy. The NRC rules for fitness-for-duty and drug testing, plant design standardization, and intergovernmental emergency planning have contributed to the ever-improving safety and performance achievements by the nuclear power industry over the past few years.

Management at most of the nation's nuclear power plants continue to focus on and demand better safety. 1989 performance indicators for the industry demonstrate that U.S. commercial nuclear power plants are having fewer unplanned shut-downs, lower incidence of worker radiation exposure, and are producing electricity more often.

As congress and the NRC look at creating advanced reactor design standards and reforming licensing procedures, I am hopeful that there continues to be room for innovation. One of the great strengths of our nation is our innovative and enterprising spirit. As policy-makers we should strive to create a regulatory regime that encourages creativity and allows for competition and the ability for entrance in the market for advanced nuclear reactors. So, although there are many impressive advanced reactor designs ready for NRC approval, we should avoid new legislation or regulation that selects one technological approach, one nuclear reactor, or one company over another.

Standardization of plant design and licensing reform should be initiated so that the NRC can get out from under political issues associated with the construction of new nuclear power plants. NRC should be able to put their stamp of approval on a plant design or license without being mired in lawsuits and procedures.

## WASTE DISPOSAL STILL A CHALLENGE

Having said all this, I'll return to the issue at hand—High Level Waste. Our energy independence is too important to continue to ignore the benefits of nuclear power, yet high level waste disposal continues to stay out of our reach. It wasn't that way in 1987. In that year, Congress decided that a deep geological repository was the safest, most scientifically sound way to dispose of this kind of waste. Congress also picked the Yucca Mountain site as the best choice and ordered DOE to "characterize" it.

In response to this action, the State of Nevada went to court. Now, federal judges are going to decide the case.

As we await the outcome, we must find a scientific approach to the problems associated with the handling, transporting, and disposing of this waste. I am confident that we can design systems and train people needed to do this. However, we make up our minds about what we are going to tell the designers and trainers. We need a health-based standard from the Environmental Protection Agency that tells us what's safe. We cannot just say "protect the public health and the environment" and leave it at that. That approach has bankrupted our Superfund program, lined many a lawyer's pocket with taxpayers' money, and is threatening to cause an Environmental S&L Crisis. EPA's health standards so far have been based on virtually zero tolerance. This isn't just silly policy, it's obstructionist and onerous.

The Nuclear Regulatory Commission, likewise, has been zealous in its regulatory role in this process. The current set of NRC licensing rules read like the lyrics to, "I Lost My Heart on Yucca Mountain." The NRC ought to prepare rules that will license a high level waste repository—no matter where it is sited. Their approach,

based on the unreachable goals set by the proposed EPA health standard, naturally lead most Nevadans, and most Idahoans, to conclude that this job is just plain hopeless.

#### CONCLUSION

Because of these agencies' assumptions about the risks involved, they have, perhaps unwittingly, "rigged the game." Today's technology and human ability can handle this waste safely. Yet, today, we seem to be no closer to a realistic regulatory approach for the permitting of a high level waste repository—at Yucca Mountain or anywhere else—than we were in 1987.

Hopefully, the witnesses at this hearing can explain this and give us some guidance and perspective about what can be done to move this process forward.

Senator GRAHAM. Thank you, Senator.

Number one, several panelists had commented as to what they believed the agenda for the Congress should be relative to this issue. That is our immediate work product from the series of these hearings: what we should be laying down as the starting point for the congressional debate on all of the issues that have been identified as critical to the future of nuclear power in the United States.

I'd like to ask if any of the other panelists would like to add to the list of congressional recommendations that we have already received this morning.

Number two, several of you have commented about the issue of the internal negotiations among the various agencies involved, particularly the Department of Energy, the NRC, and the EPA. Are there any comments as to the status of the structure within those "internal to the agency" issues which are being resolved? Specifically, is there any role for Congress, beyond oversight, in those issues?

Mr. Bernero.

Mr. BERNERO. Mr. Chairman, I would just like to observe—in our testimony we have noted that we are actively working with the Environmental Protection Agency on the modifications of its high-level waste standard, and we have a parallel activity associated with developing our own regulations on how to implement that standard. It's been proposed that we consider negotiated rule-making, the legal process of negotiated rule-making, for dealing with that.

We're looking at different ways of conducting the dialogue with EPA and our own rule-making development in an appropriately public way to forward that. It may or may not be the exact legal formula of negotiated rule-making, but it could be very similar.

Senator GRAHAM. Doctor Shapiro.

Mr. SHAPIRO. Just to supplement those comments, again, I think we share NRC's views that we need an open exchange of information and dialogue. The discussions that have gone on up until now the comments we received have all been submitted to the record, so it's a public activity.

The negotiated rule-making process is a very formal procedure designed to safeguard the protections built into the Administrative Procedures Act. For EPA to proceed with such an activity, we would have to make sure that all of the interested parties were willing and able to participate in the negotiating process and they are willing to enter those negotiations in good faith so that there is a reasonable expectation that agreement could be reached at the



end of that process. But it would involve, clearly, many more parties than just EPA and NRC.

Senator GRAHAM. Are there any other comments on that issue? Doctor Fairhurst.

Mr. FAIRHURST. I'd just like to comment. A comment was made that our report was the result of a 1988 meeting, which was before Secretary Watkins arrived on the scene. I would like to say that the Board does agree that a number of the recommendations that we have made, particularly those concerning dialogue between the agencies and some modifications of schedule, have indeed been taken and are being taken. We welcome those particular steps.

It is true that quite a bit has happened since we've had our meeting.

Senator GRAHAM. Several panelists alluded to the MRS, the Monitored Retrievable Storage issue. All of those who have commented have indicated a sense that we should facilitate development of such an MRS. Is there any contrary advice relative to the MRS?

What would be required in order to facilitate the establishment of an MRS? What would be required from Congress?

Mr. Bartlett.

Mr. BARTLETT. Mr. Chairman, I wonder if I might take a shot at answering that question.

As you're aware, Mr. Leroy is beginning to proceed with his efforts to implement his office, and we are providing support to that office in his efforts, as requested. Our anticipation and hope is that Mr. Leroy will be successful in identifying one or more candidate host States or Indian tribes within approximately the next year. The outcome of that identification and negotiation with the potential host should be a package which, under the Nuclear Waste Policy Act as amended, has to come before the Congress for approval.

Basically, there are two things that the Congress could do to facilitate that: once the package arrives for your consideration, act on it expeditiously; and second, include in that action a de-linking of the present requirements which have the schedule for the MRS facility on the same schedule as the repository facility. For the MRS to be effective, it simply must be on an earlier independent schedule. Those are two specific actions through which the Congress could be a great help to the program.

Senator GRAHAM. Are there any other comments on what Congress should consider relative to the MRS?

Mr. Wilson.

Mr. WILSON. Mr. Chairman, I think that the comment that there may need to be a delinking of the permanent repository from the MRS certainly is one that should be examined. Of course, our concern is that there are many reactor sites around the Country that will need to have a place to store waste far earlier than when the permanent repository will be constructed and ready to accept waste. Many of these will be in need either before or right at 1998. So the need to have some central place to store this waste is critical.

Senator GRAHAM. You indicated that a number of nuclear sites would reach their saturation by approximately the date of the per-

manent disposal site is now intended to be opened, roughly the year 2010. Do you—

Mr. WILSON. That's an NRC determination.

Senator GRAHAM. Does someone have a schedule of when—on a site-by-site basis—it's anticipated that the maximum on-site storage capability will be reached?

Mr. BERNERO. Mr. Chairman, in our licensing control of reactor sites and spent fuel storage, we have already reached a point that might fit that description since a number of utilities have applied for licenses for dry storage. In other words, they're not further expanding the wet pool storage, but are building in the site environment their concrete bunkers or pads for dry casks.

That gives an almost unlimited capacity—a lifetime sort of storage capacity—to a reactor site. We, right now, have licensed three such installations in the United States and have a number of other applications under review.

Senator GRAHAM. What's your assessment of the safety and health aspects of that dry storage?

Mr. BERNERO. We examined these very carefully, and have authorized them only with the confidence that, subject to the conditions of license and the robust designs involved, this sort of dry storage for spent fuel is quite safe, and safe for many years.

Senator GRAHAM. Did you do that licensure with any expectation of when there would be a permanent disposal site?

Mr. BERNERO. No, we recognized that there was going to be some delay. We have issued these licenses for 20 year terms, but taking into full account the possibility that that might even require renewal or extension.

Senator GRAHAM. Are there any other comments on that question?

[No response.]

Senator GRAHAM. Senator Simpson.

Senator SIMPSON. Thank you, Mr. Chairman.

That issue of the MRS versus the permanent repository has always squirreled around in fear that the MRS would become the permanent one if we allow it to happen. It's that simple. I remember Senator Bennett Johnston was deeply involved in that debate some number of years ago. It's troubling. But, I did make obvious comments about EPA. I listened to your remarks, Mr. Shapiro, and I appreciate that. They were not directed to you.

I wonder, we have this Technical Review Board, and the Board on Radioactive Waste Management. They've recommended that the EPA should reevaluate the standard, 40 CFR 191. To consider the doses the general population receives from routine exposures from natural sources of radiation, and really the concept of "as low as reasonably achievable" is really inappropriate for a repository, not only inappropriate, but even absurd.

In dealing with the EPA over the years—and long before you have testified—to get to situations where the EPA sets dose levels that are less than natural background in the Pumpkin Butte area of Wyoming or anywhere in New Mexico, makes you lose credibility in that agency. Or, as one of our colleagues years ago, in an historically almost mythical exercise, took a geiger counter and pressed it against one of the granite buildings here in Washington,

D.C. and got a count—which you will get in direct sunlight on granite—which is greater than some of the stuff that's being talked about in the regulations. These things are imponderable for the average citizens, and even Congressmen, to deal with.

How is EPA addressing this recommendation that has been proposed, and how can you explain to what degree the standard is being reevaluated to use a dose requirement when setting a regulatory standard for a deep geologic permanent repository? How do you resolve that?

Mr. SHAPIRO. As you pointed out, making the kinds of forecasts and projections that one has to do in licensing a facility such as a deep geologic repository is very difficult. Our standards were based initially on an assessment of the kinds of performance we anticipated from such a storage facility when properly sited and constructed. Therefore, although stringent, we believe they were achievable and would satisfy the public's need for assurance that risks were being adequately dealt with.

I think one of the things that you pointed out in your statement was the fact that one possible comparison point would be the exposure projected from such a facility relative to natural background. Indeed, that is certainly one viable benchmark. I think, in dealing with the public on a number of related risk issues, we find that the public tends to perceive risk issues very differently when they're associated with natural or voluntary kinds of circumstances relative to those that are a result of deliberate activity by the Government or by the private sector. One has to take that sensitivity into account when trying to devise a scheme that really creates public confidence in the viability of the overall regulatory framework.

Senator SIMPSON. I fail to see how public confidence can come about when we have 112 reactors with this material which could be critical if anything were to happen to the fluid that were around them. What do you think the public thinks of that? I think you ought to be addressing that. If you really want to spook the public up, why don't you spook them up with reality?

Mr. SHAPIRO. I think that's a very important point, and we are committed to developing standards that are implementable and workable and that do not impede the development of a sound disposal facility because we share the general consensus which has been expressed at this panel, that this is the most viable solution for high-level waste management.

Senator SIMPSON. What will EPA do now with the recommendation of negotiation with DOE on the precise definition of the standards and regulations? Are you ready to do that?

Mr. SHAPIRO. We're ready to evaluate it, as I indicated and as Mr. Bernero indicated. I think the process of developing a formal negotiation to establish a rule involves more than just the particular Federal agencies getting together. It's a public process that would have to solicit and involve all the interested parties who believe they have a stake in the regulation and provide them with equal opportunity to agree with the ultimate results of the negotiation. EPA has a formal process—I'm sure that NRC has something similar—to evaluate the potential for a successful negotiated rule-making process.

We certainly think, given the level of frustration with respect to the difficulty of developing these standards and defending them in court, that if it were possible to expeditiously move toward a negotiated rule-making, that would be a very attractive option. We're going to evaluate that.

Senator SIMPSON. I think that would be attractive. It's called "talking." It works, and it's something that we have to do in our daily life as legislators. You can make it so formal that it just becomes a sterile exercise, or you can start talking about negotiating what is reality here on precise definitions, without dealing with bright line theories of exposure, like we had to do with the Clean Air Act. How far from the powerplant boundary a man standing with his shirt off for 73 years; how soon would he die? That's called the "Fantasy of the Maximum Incredible Hermit." [Laughter.]

So I think that if we can just stay real on this stuff, talk, see what revisions can be made, and how to do this in some way that they end up respecting your credibility and ours, because it's tied with real life and not some fantasy of exposure and dose levels which approach background and can't be reached, when, meanwhile, 112 reactors are cranking it out.

I thank you, Mr. Chairman.

Senator GRAHAM. Senator Reid.

Senator REID. Mr. Chairman, with the great respect I have for my senior colleague from Wyoming——

Senator SIMPSON. Junior. I'm not the Senior Senator.

Senator REID. No, but you're my senior colleague.

Senator SIMPSON. Oh. [Laughter.]

That's very good, Harry. I like that. [Laughter.]

Senator REID. What I always say, and what we all say in Nevada, why don't you take it in Wyoming, then, if it's so safe? [Laughter.]

Senator SIMPSON. Why not Florida?

Senator REID. Well, Mr. Chairman, I have some questions to ask the panel.

Let's look at what's going on in New Mexico. We have the Waste Isolation Pilot Project there. It contains tunnels for the emplacement of waste in salt formations some 2,000 feet underground. It's my understanding that WIPP must also meet the EPA standards for nuclear waste disposal. Is that right?

Mr. SHAPIRO. I think in its current plan, the DOE is committed to meeting EPA standards. Legally, at this point, it does not have to meet EPA standards.

Senator REID. Has there been a determination made whether it can meet those standards?

Mr. SHAPIRO. Maybe I should ask DOE. DOE is actually responsible, under EPA standards, to make the determination.

Senator REID. The WIPP facility, Doctor Bartlett, is being used right now, is that right? For storage of nuclear waste?

Mr. BARTLETT. No, it isn't, Senator.

Senator REID. Has it ever been?

Mr. BARTLETT. Not to this time.

Senator REID. Will it ever be?

Mr. BARTLETT. Assuming it goes through the process of all the acceptance proceedings that are yet to be completed——



Senator REID. Could somebody tell me what's going on in New Mexico, then? Is there just a hole there?

Mr. SHAPIRO. DOE has applied for a no migration waiver from EPA which would allow them to begin—

Senator GRAHAM. Excuse me. What did they apply for? Did you say a "no migration waiver"?

Mr. SHAPIRO. A no migration waiver under RCRA, the Resource Conservation and Recovery Act, in order to perform some of the experiments DOE believes are necessary to characterize the site. They applied to EPA for a no migration waiver which would allow them to place a small fraction of the ultimate waste material on the site to perform the experiments that are necessary in order to fully characterize the site so that they can prepare the characterization necessary for the operation of the facility.

Senator REID. The WIPP facility was supposed to be in operation a while ago, was that not right?

Does anyone know?

Who are you?

Mr. GUIMOND. My name is Richard Guimond. I'm Director of Radiation Programs at EPA.

Senator REID. This, Mr. Chairman, is one of the problems that we have in Nevada. Here is a facility in New Mexico. I don't know how many millions of dollars have been spent in this. It appears that there isn't much known about it. I think it's worth noting that the early performance assessments conducted for the Department of Energy on the Waste Isolation Plant Facility in New Mexico show reasonable confidence that compliance with the standard is achievable.

Does anyone reject that statement?

Senator GRAHAM. Doctor Fairhurst.

Senator REID. You do reject that?

Mr. FAIRHURST. Yes. Part of my work for the Board on Radioactive Waste Management is to act as Chairman of the Academy's overview committee for the WIPP project. It appears—and this is not yet official, work is still going on—but current feeling is that the WIPP site could probably meet EPA standards with the exception of the so-called "human intrusion" scenario. This is the idea that sometime in the future somebody comes and drills directly into a repository and develops a preferred pathway to the surface.

So for all the natural undisturbed conditions, it is felt that it probably could, although that argument has not been formally presented as yet.

Senator REID. I think it's important to note that the U.S. Nuclear Regulatory Commissioner, James Curtiss, at a symposium that was sponsored by the National Research Council said there that—I want everyone here to understand that I didn't make up this "juggling numbers." That is specifically what a commissioner of the Nuclear Regulatory Commission said. He said that he felt that the Energy Department should have greater freedom to "juggle numbers" as long as the overall performance of the repository wasn't too greatly affected.

I think that says a great deal about the Nuclear Regulatory Commission being fair in this whole approach. I applaud and commend the Environmental Protection Agency which said, a day after

that—the Director of EPA's Radiation Programs, Richard Guimond, told the same conference, a largely pro-nuclear conference, that his agency is not going to relax its standards for licensing an underground repository. I think that says a lot and I think the public supports that.

Mr. Guimond went on to say,

The public is concerned about nuclear power related issues. The public is concerned about the disposal of high-level radioactive waste, and if we treat the disposal of high-level radioactive waste the way we treat municipal landfills, we're just not going to dispose of high-level radioactive waste.

He further said,

We should be demanding that we have extremely restrictive standards.

Doctor Bernero stated earlier in his testimony that he felt that the figure should be juggled.

Mr. BERNERO. No, sir. I think it's fair to Mr. Curtiss and to the NRC if we would point out that in the NRC regulations there are separate performance criteria, called "the subsystem performance criteria", wherein there is a very strict deterministic requirement for package lifetime, for the leakage rate from the package once it eventually leaks, and for the geologic isolation, at least as measured by ground water travel time.

And Commissioner Curtiss has long been concerned and active in discussion within the NRC about the redundancy of having in our regulation the EPA performance assessment standard and these separate and virtually equivalent standards by another method. I think a fair interpretation of what Mr. Curtiss said—and has often said to me and in my presence—is a concern about the undue litigation of two separate calculations for the same result or purpose rather than addressing the stringency of it. The NRC considers the stringency question open. We've asked the EPA to try to illuminate the connection between their surrogate calculation for a release quantity, population dose, and individual dose. It's a very difficult connection to make.

Senator REID. But the act, both in 1982 and 1987, set up redundancy purposely. It's obvious that the reason why is so that there would be back-ups just like we have on our space vehicles. You have redundant systems in case one fails or there is miscalculation. That's the reason they are there. I hope the EPA hangs tight on that.

Let me ask this, Mr. Chairman, Chairman Carr testified on February 8th of this year before the House Interior Committee that there is sufficient spent fuel storage capacity through the year 2025. Does anyone disagree with what Chairman Carr said?

[No response.]

Senator REID. If this is the case, I would ask everyone here why we appear to be rushing toward a high-level waste repository when—and maybe, Doctor Deere, you can respond to this. You have said that there is world-wide acceptance of geologic burial. But if there is world-wide acceptance, where do they have geologic burial?

Mr. DEERE. There is no high-level waste, to my knowledge, that has been stored. There has been low-level and some medium-level, and the countries are actively moving in that direction.

Senator REID. But, I think that you should be careful how you make that statement. World-wide acceptance, geologic burial—but I think you should add the caveat that no one else has done it. The great experiment is taking place in the State of Nevada—or, they're trying to experiment there. I think that statements like you made give a general impression that all over the world they're burying, geologically, nuclear waste, and there couldn't be anything further from the truth.

In fact, in Europe, it's stored on top of the ground or right under the ground. Isn't that right?

Mr. DEERE. But their plans and their studies incorporate deep geologic burial, and they are moving in exactly the same direction we are.

Senator REID. Doctor Deere, the places that I'm familiar with that have tried—for example, in Germany—geologic burial was a dismal failure. So where are they advancing so quickly? Give me an example.

Mr. DEERE. In Gorleben, in Germany, in——

Senator REID. Is that in the salt caverns?

Mr. DEERE. This is in salt.

Senator REID. I hope they have better luck than they had last time.

Mr. DEERE. Well, that had nothing to do, I don't think, with the concept of deep burial in salt, but they are moving toward that particular burial.

Senator REID. Where else?

Mr. DEERE. In Sweden.

Senator REID. What are they doing in Sweden?

Mr. DEERE. In Sweden they are completing their studies in an existing deep mine where they have been carrying out various types of characterization studies of ground water flow systems, ways of grouting, and now they're moving towards a large scale experiment which will be a tunnel spiraling down to a depth of perhaps greater than 1,000 or 2,000 feet—I don't have it clearly in mind at the moment—where they will continue their studies. They are doing this in preparation for selecting their site from one of three that have already been established.

So these processes will be going on concurrently. As I understand it, they will be going on over the next three years.

Senator REID. We've established, I think, in this hearing, that there is, according to Chairman Carr, presently, sufficient capacity to store up through 2025.

Go ahead, Mr. Keesler.

Mr. KEESLER. Senator, let me read, if I might, for you from a publication from the Electric Power Research Institute.

Senator REID. Sure.

Mr. KEESLER. It states, "The number of nuclear plants with spent reactor fuel that cannot be accommodated in storage pools and the volume of fuel requiring dry storage are expected to increase over the next two decades." This chart shows, sir, 150 tons at four plants in 1990.

Senator REID. So that's more than—I don't know if you testified here earlier today—but somebody said 30—

Mr. KEESLER. Going to 12,300 tons at 80 plant locations in the year 2010—that comes from this publication—so that doesn't tell me that there is, in spent fuel, that we have the capability of on-site storage through the year 2025, but we have to go to dry cask storage for this much volume.

Senator REID. So you disagree with Chairman Carr?

Mr. KEESLER. I can only read, sir, what this is saying in this publication.

Senator REID. Okay.

Mr. KEESLER. Perhaps the NRC can—

Senator REID. Yes.

Mr. BERNERO. I think we need to clarify what Chairman Carr was referring to.

Senator REID. We're doing a lot of clarifying with the commissioner.

Mr. BERNERO. Yes. He is not saying that there exists capacity already constructed. We have licensed dry storage and with further licensing of dry storage it is possible for all the U.S. reactor sites to store locally the spent fuel safely until that time.

Senator REID. As you had indicated in your earlier testimony, that's what you were talking about?

Mr. BERNERO. Yes. That particular issue and that date are associated with the Commission's waste confidence finding, which was just published.

Senator REID. You've indicated that the license that you've given—is this for the dry cask storage?

Mr. BERNERO. Yes.

Senator REID. You said that's safe for many years, but it's been licensed for 20 years?

Mr. BERNERO. A term of 20 years, subject to renewal or extension.

Senator REID. You said, "safe for many years". What is many years in your estimation?

Mr. BERNERO. In the waste confidence proceeding, which was the support of the Commission's statement which you quoted, the staff very carefully considered the technical factors and concluded that such storage could be safe for at least 100 years.

Senator REID. I have some other things, but I know that I've taken a long time, Mr. Chairman.

Senator GRAHAM. Thank you, Senator.

I think that the line of questioning which you have just engaged in is very important because it relates to the sense of urgency of getting on with a permanent disposal site and it also relates to the subject of our last hearing, which was the relationship between a disposal policy and the willingness of utilities and regulatory bodies to go forward with new plant construction.

Mr. Keesler, on behalf of the industry, how satisfactory is the prospect of on-site dry storage for extended periods of time, and what effect would that prospect likely have on the willingness of the industry to expand its nuclear capacity?

Mr. KEESLER. Mr. Chairman, in answer to part one of that question, I think it is satisfactory for probably the lifetime of the next



reactors that are built, as was said earlier, 100 years or more. But I think the industry is much more concerned that we don't pass onto future generations problems that we have to solve today.

I think I can speak for the industry and say that we would be unwilling to move forward, at the massive cost of money to build nuclear generation, until we have resolutions for the permanent problem of spent fuel. It is too great a gamble, billions of dollars have been thrown out of the customer rate base in the past 10 to 15 years in the nuclear area, and I don't think the industry is willing to move forward until this problem is resolved, and is resolved in permanency and not just in storage.

Senator GRAHAM. Are you saying that you do not believe that the industry will expand nuclear capacity without a permanent disposal site, i.e., that they would not rely upon on-site disposal methods?

Mr. KEESLER. Absolutely, sir. That's what I'm saying.

Senator GRAHAM. I'd like to turn to another dimension of this, that is the safety question. What is—speaking of absolute standards and relative standards, how do the three alternatives that we have discussed today—on-site disposal, disposal at a monitorable site, and permanent disposal—what is the relative safety and health implications of those three alternatives?

Mr. BERNERO. Mr. Chairman, If I might speak to that issue first, since we are responsible to license all three—as far as on-site dry storage and monitored retrievable storage are concerned, we have already licensed something in both cases. There is a commercial Monitored Retrievable Storage facility in the United States.

Senator REID. Where is that?

Mr. BERNERO. It's in Morris, Illinois. It's a small facility that holds 700 tons of fuel. It's owned and operated by the General Electric Company.

Senator GRAHAM. Is that high-level spent fuel?

Mr. BERNERO. Yes, it's spent reactor fuel.

These facilities—the dry storage, the “at reactor” storage, and the Monitored Retrievable Storage—are under continuous surveillance and direct surveillance. They are very conservative designs, very robust, and quite safe. The difference between them and geologic disposal is the difference of time scale and the desire to have remote isolation so that society can, in effect, turn its back on the disposal site. It is so remote that one need not demand continuous surveillance. Not that such surveillance would be forbidden, it's just that one would not rely on it.

That is the principal difference between the standards of safety. The geologic disposal requires prediction out into the great future—many, many generations into the future—taking into account the half lives of these long-lived nuclides.

Senator GRAHAM. Any other comments on the relative safety aspects of the three choices?

Mr. Wilson.

Mr. WILSON. Mr. Chairman, I don't know that this really fits in with the comments on that, but let me just reinject a concern that I expressed earlier when we were discussing permanent repository, dry cask storage on-site, or an MRS.

We're talking about spending money here. The ratepayers are faced with a continual outflow of approximately \$500 million a year that's going into the Nuclear Waste Fund. They will be paying for on-site storage at the different sites around the Country as well as an MRS. I would hope that the concern that we have about ratepayers paying one, two, or three times for essentially the same service would be kept in mind in all of these discussions.

One of our concerns would be that if the EPA is going to reexamine some of its standards for the NRC that there be some firm time frame set on that because it seems to me a little bit foolish to have the DOE going out and attempting to construct and design a permanent repository while the standards for such construction are being changed. To leave that kind of thing open, to me, makes dollar signs flash in my eyes and I see ratepayers financing any delay that would occur in the program by any of these alternatives that have been discussed.

Senator REID. Mr. Chairman, would you yield so that I could follow-up on this?

Senator GRAHAM. Sure.

Senator REID. I think you brought up an interesting point, and I would like an answer. How costly is it to store these spent fuel rods on-site compared to what's happening? You're concerned about the cost, and we've heard here that for at least 100 years it would be safe. Does it cost much to put it in these dry casks?

Mr. Bartlett.

Mr. BARTLETT. Mr. Chairman, I just happen to have an answer to that. We have a table prepared for the Department which I'd be very pleased to submit for the record. This addresses both questions that we previously addressed concerning numbers of sites requiring storage in the future, in addition to what they have right now, and the costs associated with that.

If I might briefly summarize what the table says, before 1998, 27 sites would have need for additional storage capacity. In the time frame 1998 to 2010, it increases to 35 sites, and then through 2025 it increases to 62 sites. The costs associated with that—before 1998, those 27 sites having to have incremental storage capacity, would be approximately \$166 million. Going through 2010, the cost is very nearly \$1 billion. For the 62 sites, listed here is in fact \$939 million in additional monies.

So the costs are, as Mr. Wilson indicated, substantial.  
[The table referred to follows:]

TABLE 1. OUT-OF-POOL STORAGE REQUIREMENTS 1998 - 2010  
COST OF OUT-OF-POOL STORAGE

| STATE                    | NUMBER OF REACTOR<br>POOLS WITH OUT-OF-POOL<br>STORAGE REQUIREMENTS |                 |                 | COST OF OUT-OF-POOL<br>STORAGE REQUIREMENTS<br>(THOUSANDS OF \$) |                 |                 |
|--------------------------|---------------------------------------------------------------------|-----------------|-----------------|------------------------------------------------------------------|-----------------|-----------------|
|                          | BEFORE<br>1998                                                      | 1998 TO<br>2010 | THROUGH<br>2010 | BEFORE<br>1998                                                   | 1998 TO<br>2010 | THROUGH<br>2010 |
| ARIZONA (3) <sup>1</sup> | 0                                                                   | 3               | 3               | \$0                                                              | \$12,782        | \$12,782        |
| ARKANSAS (2)             | 1                                                                   | 1               | 2               | \$616                                                            | \$22,946        | \$23,562        |
| CALIFORNIA (3)           | 1                                                                   | 0               | 1               | \$11,550                                                         | \$41,041        | \$52,591        |
| CONNECTICUT (3)          | 2                                                                   | 1               | 3               | \$14,938                                                         | \$26,796        | \$41,734        |
| FLORIDA (4)              | 1                                                                   | 2               | 3               | \$7,777                                                          | \$15,323        | \$23,100        |
| GEORGIA (2)              | 0                                                                   | 1               | 1               | \$0                                                              | \$18,172        | \$18,172        |
| ILLINOIS (9)             | 2                                                                   | 4               | 6               | \$13,937                                                         | \$90,706        | 104,643         |
| IOWA (1)                 | 0                                                                   | 1               | 1               | \$0                                                              | \$4,312         | \$4,312         |
| LOUISIANA (2)            | 0                                                                   | 2               | 2               | \$0                                                              | \$16,016        | \$16,016        |
| MAINE (1)                | 1                                                                   | 0               | 1               | \$693                                                            | \$12,474        | \$13,167        |
| MARYLAND (2)             | 1                                                                   | 0               | 1               | \$12,936                                                         | \$26,488        | \$39,424        |
| MASSACHUSETTS (1)        | 1                                                                   | 0               | 1               | \$2,387                                                          | \$10,241        | \$12,628        |
| MICHIGAN (5)             | 4                                                                   | 0               | 4               | \$8,393                                                          | \$62,678        | \$71,071        |
| MINNESOTA (2)            | 1                                                                   | 0               | 1               | \$8,162                                                          | \$19,558        | \$27,720        |
| MISSISSIPPI (1)          | 0                                                                   | 1               | 1               | \$0                                                              | \$12,397        | \$12,397        |
| MISSOURI (1)             | 0                                                                   | 1               | 1               | \$0                                                              | \$2,926         | \$2,926         |
| NEBRASKA (2)             | 1                                                                   | 1               | 2               | \$1,309                                                          | \$13,629        | \$14,938        |
| NEW JERSEY (2)           | 1                                                                   | 1               | 2               | \$77                                                             | \$7,931         | \$8,008         |
| NEW YORK (3)             | 1                                                                   | 2               | 3               | \$3,388                                                          | \$30,569        | \$33,957        |
| NORTH CAROLINA (4)       | 2                                                                   | 2               | 4               | \$17,556                                                         | \$36,729        | \$54,285        |
| OHIO (1)                 | 0                                                                   | 1               | 1               | \$0                                                              | \$9,394         | \$9,394         |
| OREGON (1)               | 0                                                                   | 1               | 1               | \$0                                                              | \$12,859        | \$12,859        |
| PENNSYLVANIA (8)         | 2                                                                   | 4               | 6               | \$3,542                                                          | 103,103         | 106,645         |
| SOUTH CAROLINA (4)       | 3                                                                   | 0               | 3               | \$31,185                                                         | \$46,585        | \$77,770        |
| TENNESSEE (4)            | 0                                                                   | 2               | 2               | \$0                                                              | \$23,947        | \$23,947        |
| VERMONT (1)              | 0                                                                   | 1               | 1               | \$0                                                              | \$6,468         | \$6,468         |
| VIRGINIA (4)             | 1                                                                   | 1               | 2               | \$20,405                                                         | \$39,116        | \$59,521        |
| WASHINGTON (1)           | 0                                                                   | 1               | 1               | \$0                                                              | \$16,632        | \$16,632        |
| WISCONSIN (3)            | 1                                                                   | 1               | 2               | \$7,777                                                          | \$31,416        | \$39,193        |
| TOTALS (80)              | 27                                                                  | 35              | 62              | \$166,628                                                        | \$773,234       | \$939,862       |

<sup>1</sup> The numbers in parenthesis represent the number of reactors served by the pools.

Senator GRAHAM. Just running, without the benefit of a calculator and it's been a number of years since my high school arithmetic, that would be approximately \$15 million per site as the cost of preparing it?

Mr. BARTLETT. You're very good at mathematics.

Senator REID. \$15 million?

Senator GRAHAM. Did you want to pursue that?

Senator REID. No, that's fine.

Senator GRAHAM. Senator Simpson alluded to one of the concerns about delinking the permanent program from MRS, that is that once an MRS was established that it would undercut the commitment, the will, and the motivation to establish a permanent site. There is a law of physics that nuclear waste, once deposited, tends to stay in the same place forever.

What is the sense of the panel in terms of the issue of delinking the MRS from the permanent repository and the effect that that would likely have on the time scale or the eventuality for establishing a permanent repository?

Mr. BARTLETT. Mr. Chairman, if I might address that first, let me repeat and amplify a statement that I made in my opening statement. The Monitored Retrievable Storage facility is an essential part of the waste management system. It serves a purpose very different from the function of the repository or the disposal facility.

Primarily what it does is provide the flexibility, reliability, and operability of the system from storage at reactors on through to disposal that the entire waste management system needs.

In that sense, I describe it as the analog to your regional post office, to your package transfer facility where things go in and things go out after appropriate massaging. In fact, one of my favorite analogies is your checkbook, where funds come in from various sources and you manage them appropriately to their ultimate destination. That is the function of the Monitored Retrievable Storage facility.

Senator REID. What's wrong with that is that you send your checks to various places and not all to one place.

Mr. BARTLETT. That is a difference, granted, Senator, but fundamentally the concept of providing flexibility and reliability in the system is the real fundamental issue here. It would happen, yes indeed, that if there is only one Monitored Retrievable Storage facility and only one repository, wherever it be, what we would still have is a pathway and the means to provide the flexibility for transport of materials between those two functions.

Senator GRAHAM. There's another difference. In the case of both the checks and the letters, the recipient generally wants to have them arrive. [Laughter.]

Mr. BARTLETT. And sometimes you say, "The check's in the mail," too. [Laughter.]

So, let me emphasize again, the MRS facility provides a different service. And, as we've been talking here this morning, and indicated just in some of the figures that we've been using, there is need of that service to relieve the pressure of storage at the reactor sites. So timely implementation of the MRS, independent of the disposal function, is absolutely essential in my mind.



Now, to accomplish that, what's also essential is for us and the Congress to assure that the MRS operations or activities within our program and the disposal activities proceed in parallel in order to assure that there's not even the perception that an MRS facility is, in fact, a de facto repository. We intend, in our planning, to make sure that these two activities are separate, are tracking appropriately their individual objectives, and this is one area where we would seek facilitation of that effort from the Congress.

Senator GRAHAM. Are there any other comments on the effect of a policy that attempted to expedite the establishment of an MRS on the ongoing permanent disposal site issue?

Mr. Keesler.

Mr. KEESLER. Mr. Chairman, I think it is the only thing that we, as the industry, see representing the ratepayers, that will avoid them paying twice and will avoid the \$1 billion for the dry cask storage, which is the number that Doctor Bartlett gave. I believe it is the only opportunity to fulfill the contract that we feel is between us and DOE for the collection of this money, so that we have a place that we can start putting spent fuel in the year 1998.

Senator GRAHAM. Mr. Wilson.

Mr. WILSON. Senator, staying in your analogy, speaking as the representative of the ones who write the check, and will go through the clearing account, we have had mixed feelings about the MRS because of the concern that an MRS might be perceived as—once the waste gets there, that's where it would stay. We would not want to lose—

Senator REID. Can I interject here? Can you tell me why that's a concern?

Mr. WILSON. It's the same concern that I would have that if you make the storage of nuclear waste look permanent at the current reactor sites, it would lessen the sense of urgency that we have certainly tried to create with respect to getting this nuclear waste program back on track, managed well, and get a repository constructed. Anything that looks like permanent storage, but short of that permanent storage, would concern us.

We do see the value—and I think in order for the DOE to ever receive this waste in 1998, as they have committed to do, they're almost going to have to have an MRS repository in order for them to do that. I don't think they're going to store it over at the DOE headquarters. [Laughter.]

But they're going to have to have someplace to put it. Our fear has been on the other side of that—

Senator REID. I think we should start in Wyoming. [Laughter.]

Mr. WILSON. Well, in the absence of the Senator—

Senator REID. That's why I said that. [Laughter.]

Mr. DEERE. Mr. Chairman, may I add a point?

Senator GRAHAM. Certainly. Go ahead.

Mr. DEERE. I think we have to remember that the site to be characterized may prove not to be suitable. This could be a number of years down the road. An MRS, starting at about now, or whenever is a place where the waste can be accumulated while another site is being investigated, because we really can't assume that the final site is the Nevada site. That's the candidate site. But there are uncertainties.

Senator REID. Mr. Chairman, would you allow me to ask some more questions that are appropriate?

Senator GRAHAM. Yes.

Senator REID. Then I'll stop.

Doctor Deere, I have a question for you, in that you represent the Nuclear Waste Technical Review Board.

The 1987 Act amendments establish that the Nuclear Waste Technical Review Board was to evaluate the technical and scientific validity of activities undertaken by the Secretary including site characterization activities and activities relating to the packaging or transportation of high-level radioactive waste or spent fuel.

Mr. DEERE. Yes.

Senator REID. My question is—it seems that the Board has become increasingly involved in the regulatory policy issues, including some discussion in your last report about the developing EPA standards. Within the confines of your mandate, is this activity appropriate for the Nuclear Waste Technical Review Board?

Mr. DEERE. This is a point that the Board members themselves have discussed. There are those that have felt that part of the lack of progress in the scientific and technical characterization work was due in part to factors that were not necessarily technical. It was very difficult to separate the success of a very vast scientific investigation from the restraints. Therefore, a number of members said that they felt that we must look at various aspects of it because the technical program is being affected.

Senator REID. It appears—this is to the members of the panel here—that the siting controversy between Nevada and the Federal Government is going to remain in the forefront, having the greatest day-to-day effect on the Department of Energy's progress in characterizing Yucca Mountain. Given the time and expense involved, is there some other way to try to move forward to resolving this issue?

Mr. LOUX.

Mr. LOUX. Senator, as I referred to in my remarks, certainly Nevada believes that the mission plan process that the Secretary and Doctor Bartlett are committed to is certainly a vehicle or opportunity to resolve or at least discuss and have dialogue on issues such as you have alluded to between the State and the Federal Government, as well as MRS repository issues, on-site storage issues, and the like. I would think that the Department would be well served by putting forward a draft mission plan in the near term encompassing the whole waste management field, at this point, relative to their program and putting that open for discussion with all the parties affected, including the members of Congress, for an ongoing discussion of the current program and where it's headed in all of these areas.

Senator REID. Do you see a role for the new Negotiator in that process?

Mr. LOUX. I certainly think that his role is one that is likely independent of at least a discussion of the Department's programs, per se, but certainly his activities could be considered in that context.

Senator REID. What is the difference? I keep hearing "site suitability," and I hear the term "site licensability." What, if any, is the difference?

Mr. LOUX. The State of Nevada certainly has a viewpoint on that issue, as I'm sure other parties do. We have viewed, historically, the issue of "site suitability" different from "licensability" in that the Nuclear Waste Policy Act requires the Department of Energy to evaluate the site against its siting guidelines which are noticeably absent from inclusion in the site characterization plan until the very end of site characterization, when I think the intent was that they be used early and in an ongoing fashion to determine the ongoing suitability of the site, not only early in the site characterization process, but perhaps during characterization.

The vehicle might even be semiannual site characterization progress reports where the existing database, at any given point in time, can be compared against those technical guidelines which contain specific qualifiers and disqualifiers whereas the issues associated with licensing are more related to the overall performance of the site rather than its individual characteristics.

Senator REID. Mr. Bernero.

Mr. BERNERO. I was going to say somewhat the same thing a little more administratively. Site suitability is generally associated with the process of implementing the regulation, 10 CFR 960, which is the Department of Energy's regulation for obtaining a site and developing it.

Licensability is associated with implementing 10 CFR 60, which is the NRC's license, which also embraces the EPA standard. That is the standard by which such a site would be licensed for construction and later in placement of waste.

Senator REID. Does anybody else have a comment on that?

Mr. BARTLETT. Senator, speaking operationally with respect to that, I'd like to point out that just yesterday, as a keynote speaker at the Spectrum 1990 Meeting in Knoxville, I addressed this subject in substance and I would be very glad to submit a copy of that speech for the record (see p. 194), which does describe exactly how we propose to go about evaluation of site suitability and the distinction of that from repository system licensability.

I would simply say at this point that our approach is consistent with what Mr. Loux is calling for. We will be issuing, as soon as we can, a revised mission plan which will reflect this. We will, in fact, be addressing, as soon as possible, the disqualifying factors that are contained in the 10 CFR 960 siting guidelines. Very simply, as soon as we can get back on the mountain, we will be working along that strategy.

Senator REID. Mr. Chairman, I just have a few more questions to touch upon.

There seems to be an increasing discussion in three key licensing areas. I'd like to hear from the panel about these. One is something that we touched on briefly earlier today when we talked about the WIPP facility in New Mexico, whether human intrusion potential should be treated as an integral part of repository performance assessment, as it must now be, according to EPA, or whether it should be considered as an independent element, separate from

other performance considerations? Is it possible to find a site where the potential for human intrusion is acceptably low?

Doctor Fairhurst.

Mr. FAIRHURST. There is one difference between human intrusion and all of the others. The others are based on the undisturbed geologic repository and the properties of the geologic environment's ability to isolate the waste. There's been a lot of discussion, a lot of work going on, and testing going on to try to identify the isolation capabilities.

This is a personal view. I have no official support for this. The human intrusion scenario is one that requires a great deal of conjecture about society 10,000 years from now. There are a lot of assumptions made in that scenario that one is required to examine. It mentions, for example, if one would drill down through the repository—there's a lot of development in geophysical techniques, for example, for finding deposits and looking at some techniques that are being developed right now, very impressive developments, which allow one to look at things at depth without actually going down the bore hole.

So this is one of the areas where there's a great deal of question as to how realistic it is to state that the technology several thousands years ahead will be the same as technology today. It is, in my view, one that needs to be examined separately.

Senator REID. Does anyone else have a comment on that?

Doctor Shapiro.

Mr. SHAPIRO. Yes. When EPA promulgated its regulations in 1985—and, of course, considered this issue—although we recognize the difficulties in some of the special circumstances concerning the human intrusion problem, we felt that since it was one of the really significant risk factors leading to the evaluation of the overall performance of the site, it should be considered as part of the overall evaluation of the adequacy of containment.

We did allow, in our guidance for implementing those regulations, that certain factors such as passive protection devices that could be established to try and maintain security of the site could be taken into account at the licensing stage in assessing the probability that such an intrusion might take place. In reconsideration of the regulations, we've received comments from DOE and others that we should look at the possibility of treating human intrusion separately, and we are considering that as we move toward re-proposing.

Senator REID. Should EPA standards be based on release limits for radionuclides from a repository, or should the standard be based on human exposure limits associated with a repository?

Yes, again, Doctor Shapiro.

Mr. SHAPIRO. Again, that was an issue that we had to address in 1985. We determined that focusing the assessment on the overall release from a facility was both more workable and more effective as a way of evaluating the performance of a facility since it allowed you to focus on the facility and its characterization rather than involving a large number of scenarios and pathways regarding movement from the facility to possible human exposure.

Again, that is different from the practice that a number of the members of the panel have pointed to that other countries have



used and that have been recommended to us. We will reconsider that issue as well as the possibility of perhaps developing regulations that allow you to translate from one approach to another while achieving the same overall level of public health protection.

Senator REID. Doctor Deere.

Mr. DEERE. If I might add to that answer, I believe that our Technical Review Board believes that the geology at the site must be sufficiently well-known that you can pick out the pathways. You have to go hunting for them. You have to prove that there aren't pathways. We really feel that it's additional exploration that's going to solve a lot of the uncertainties. If you can't say how the water is going to come down and leak through and where it's going to come out, then you have no way of judging whether you have an acceptable site.

So we really feel that there must be a lot of effort to understand the site. You have to take the great big question mark off the geological subject.

Senator REID. One last question. Should carbon 14 be included, as it was originally, in the EPA's table of release limits for various radionuclides, or should it be eliminated from the list?

Mr. BERNERO. I think there's a good deal of calculation going on right now with carbon 14. In the original formulation of the standards and regulations associated with them, virtually everyone assumed that the site would be a saturated medium—in other words, it would be water-filled, and therefore gases would not get out.

We are now dealing with an unsaturated medium at the Nevada site, and the carbon 14 release, given certain models, seems to be strange. It appears to exceed the standard, and yet at the same time, not bear any real direct relationship to significant risk to persons on the surface. So that is being reconsidered. It may be that, in the dialogue on further refinement of the standards, a substantial change or even elimination of carbon 14 could happen.

Senator REID. Does anyone else have a comment on that?

Doctor Shapiro.

Mr. SHAPIRO. We agree that that issue is one that needs some continuing reexamination in light of the information that is now available, but the agency has not reached any preliminary conclusions with respect to changing our regulations.

Senator REID. Are there any other comments?

[No response.]

Senator REID. Thank you, Mr. Chairman.

Senator GRAHAM. I'd like to come back to the MRS issue. How would the cost of the MRS program be accommodated within the budget of the Department of Energy?

Mr. BARTLETT. Mr. Chairman, the cost of the facility itself is considered in the total system life cycle cost estimate that is prepared annually by the Department for Congress and other interested parties. It's currently estimated, I believe—and I can check this and revise it, if necessary, in the record—the facility itself would cost about \$1.6 billion under present expectations and plans. To put that in perspective, the estimated total life cycle cost of this program, at this point in time—and I might point out that that is something in the order of an 80 to 100 year timeframe—is on the order of about \$30 billion at this point.

The cost of development—the siting development, design—I would have to check and get back to you on that, specifically.  
[The information referred to follows:]

DEPARTMENT OF ENERGY  
FY 1991 CONGRESSIONAL BUDGET REQUEST  
NUCLEAR WASTE FUND  
(dollars in thousands)

KEY ACTIVITY SUMMARY

NUCLEAR WASTE FUND

I. Preface: Monitored Retrievable Storage

Since the MRS Review Commission report has been submitted to the Congress, proceed with activities necessary to site, design, construct, obtain a license from the Nuclear Regulatory Commission (NRC), and operate a facility to perform spent nuclear fuel receipt, handling and storage, as necessary, prior to emplacement in a geologic repository. In order to ensure that all aspects of the work are conducted effectively and efficiently and that NRC regulatory requirements for licensing are met, a comprehensive quality assurance program will be developed and implemented.

II. A. Summary Table: Monitored Retrievable Storage

| Program Activity                     | FY 1989<br>Actual | FY 1990<br>Estimate | FY 1991<br>Request | % Change | FY 1992<br>Request | FY 1993<br>Request |
|--------------------------------------|-------------------|---------------------|--------------------|----------|--------------------|--------------------|
| Design and Engineering Studies.....  | \$ 4,250          | \$ 0                | \$ 1,800           | >999     | \$ 24,042          | \$ 16,788          |
| Siting.....                          | 900               | 1,500               | 2,300              | + 53     | 23,599             | 5,559              |
| Regulatory.....                      | 1,600             | 0                   | 300                | >999     | 1,443              | 2,004              |
| Licensing.....                       | 1,000             | 0                   | 1,000              | >999     | 4,225              | 1,952              |
| Environmental.....                   | 500               | 0                   | 800                | >999     | 3,091              | 4,110              |
| Project Management.....              | 1,750             | 1,500               | 1,900              | + 27     | 5,616              | 5,035              |
| Systems Support.....                 | 5,000             | 0                   | 1,900              | >999     | 7,216              | 10,275             |
| Total, Monitored Retrievable Storage | \$ 15,000         | \$ 3,000            | \$ 10,000          | +233     | \$ 69,250          | \$ 45,723          |

II. B. Major Laboratory and Facility Funding:

|                              | FY 1989 | FY 1990 | FY 1991 | % Change | FY 1992 | FY 1993 |
|------------------------------|---------|---------|---------|----------|---------|---------|
| Battelle                     | 900     | --      | --      | 0%       | --      | --      |
| Oak Ridge Operations Office  | 20      | --      | --      | 0%       | --      | --      |
| Pacific Northwest Laboratory | 79      | --      | --      | 0%       | --      | --      |
| Richland Operations Office   | 306     | --      | --      | 0%       | --      | --      |

### III. Activity Descriptions: (New BA in thousands of dollars)

| Program Activity                  | FY 1989                                                                                                                                                                                                                                            | FY 1990                                                                                                                                                                                                                                                                                                                                                                                                                           | FY 1991                                                                                                                                                                                                                                                                                                                | FY 1992                                                                                                                                                                                                                                                                                                                                    | FY 1993                                                                                                                                                                                                                                                                                                         |
|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Monitored<br>Retrievable Storage  |                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                 |
| Design and<br>Engineering Studies | <p>Performed design scoping studies including selection of spent fuel storage approach, to allow proceeding into conceptual design. Continued engineering evaluations and tradeoff studies. Developed comprehensive engineering program plans.</p> | <p>Continue the engineering studies applicable to the HES. Develop the conceptual design criteria, design performance requirements, and a systems study plan. Initiate conceptual design for a generic site. Complete plans for high priority design feature tests. Develop physical site design criteria for use in HES siting and for the Nuclear Waste Negotiator. This activity will utilize \$1,440 of prior year funds.</p> | <p>Complete the facility functions technical baseline. Complete the conceptual design and planning for Title I design. Perform design reviews and technical support studies. Initiate design feature tests and planning for prototype systems tests.</p>                                                               | <p>Maintain the technical baseline. Complete Title I trade-off studies and systems optimization studies. Complete Title I design. Complete the design feature tests and planning for prototype system tests.</p>                                                                                                                           | <p>Initiate Title II design. Initiate procurement of equipment for prototype systems tests. Collect and incorporate site data into the design for each (one or more) site under consideration.</p>                                                                                                              |
| Siting                            | <p>Began development of siting plan.</p>                                                                                                                                                                                                           | <p>Implement siting activities. Finalize siting plan; complete general information reports; begin compilation and review of existing data for identification of potentially suitable sites; develop public information materials; oversight of grants requested by an affected State or Indian Tribe; support</p>                                                                                                                 | <p>Continue siting activities; initiate preparation of draft EA; identify preferred sites for draft EA; continue development and provision of public information materials; oversight of grants; support for public/institutional involvement; support external review; commence geotechnical field activities and</p> | <p>Complete identification of preferred sites for the draft EA. Develop public information materials; oversight of grants; support public involvement; support external review; develop transportation and environmental data on alternative sites; continue geotechnical, environmental, and socioeconomic field activities; continue</p> | <p>Prepare and issue draft EA; begin public hearings; begin response to comments on draft EA; provide information materials; oversight of grants; and support public/institutional involvement; support external review; continue geotechnical, environmental, and socioeconomic field activities; continue</p> |
|                                   | \$ 4,250                                                                                                                                                                                                                                           | \$ 0                                                                                                                                                                                                                                                                                                                                                                                                                              | \$ 1,800                                                                                                                                                                                                                                                                                                               | \$ 24,062                                                                                                                                                                                                                                                                                                                                  | \$ 16,708                                                                                                                                                                                                                                                                                                       |



## III. Monitored Retrievable Storage (Cont'd):

| Program Activity | FY 1989                                                                                                                                                                                                       | FY 1990                                                                                                                                                                                                                                     | FY 1991                                                                                                                                                                                                                         | FY 1992                                                                                                               | FY 1993                                                                                                                                                                                                                                |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Siting (Cont'd)  |                                                                                                                                                                                                               |                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                 |                                                                                                                       |                                                                                                                                                                                                                                        |
|                  |                                                                                                                                                                                                               | public/institutional involvement; and support assessment of access routes and system infrastructure; commence preliminary environmental and socioeconomic field activities. The siting activities will utilize \$1,840 of prior year funds. | engineering analyses; continue socioeconomic and environmental field activities.                                                                                                                                                | engineering analyses.                                                                                                 | engineering analyses.                                                                                                                                                                                                                  |
| Regulatory       | \$ 900                                                                                                                                                                                                        | \$ 1,500                                                                                                                                                                                                                                    | \$ 2,300                                                                                                                                                                                                                        | \$ 23,599                                                                                                             | \$ 5,559                                                                                                                                                                                                                               |
|                  | Continued in-depth engineering analysis to define role and function of an MRS. Began detailed planning for regulatory compliance (NEPA compliance, State and local permitting, RCRA/CERCLA compliance, etc.). | Begin developing an MRS Regulatory Compliance Plan. Assess the modeling and data needs for an MRS Safety Analysis Report (SAR). This activity will utilize \$240 of prior year funds.                                                       | Complete the MRS Regulatory Compliance Plan. Continue to assess the MRS Safety Analysis Report (SAR) modeling and data need and develop an MRS SAR Management Plan. Perform Safety/Risk Assessment of the MRS design (Title I). | Update the MRS Regulatory Compliance Plan. Assess the Quality Assurance requirements for the SAR and compliance Plan. | Continue Safety/Risk Assessment of the MRS design and begin certification of the MRS Safety assessment models. Develop an SAR annotated outline and begin the first draft of the SAR. Assess the MRS site survey data and information. |
|                  | \$ 1,600                                                                                                                                                                                                      | \$ 0                                                                                                                                                                                                                                        | \$ 300                                                                                                                                                                                                                          | \$ 1,443                                                                                                              | \$ 2,004                                                                                                                                                                                                                               |

## III. Monitored Retrievable Storage (Cont'd):

| Program Activity | FY 1989                                                                              | FY 1990                                                                                                                                                                                                                                                                             | FY 1991                                                                                                                                                                                                                                                          | FY 1992                                                                                                                                                                 | FY 1993                                                                                                                                                                                                                           |
|------------------|--------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Licensing        | Coordinated review and interpretation of licensing-related statutes and regulations. | Continue licensing planning strategy. Review licensing issues with respect to MRS siting. Negotiate procedural agreement with MEC for pre-licensing interactions. Develop a 10CFR72 Compliance Document and a Licensing Plan. This activity will utilize \$600 of prior year funds. | Refine licensing strategy working with States and Tribes. Finalize planning. Continue MRC interactions. Continue to resolve site-related MRS licensing issues through submission of topical reports. Perform Safety/Risk Assessment of the MRS design (Title 1). | Update the MRS Regulatory Compliance Plan. Assess the Quality Assurance requirements for the SAR and compliance Plan. Continue review of design and siting information. | Continue review, refinement and coordination of MRS licensing strategy and issues. Continue submission of topical reports to MEC. Continue review of design and siting information. Begin preparation of the license application. |
| Environmental    | Initiated environmental assessment (EA) planning activities.                         | Begin collecting available information for a site Environmental Assessment (EA). This activity will utilize \$640 of prior year funds.                                                                                                                                              | Continue acquisition and analysis of information for the EA to support site selection. Hold public hearings in the vicinity of the proposed sites.                                                                                                               | Complete review and production of the EA. Submit EA to Congress at time of site selection.                                                                              | After site selection, initiate scoping process for the Environmental Impact Statement (EIS). Begin preparation of draft EIS (OEIS) to comply with NEPA requirements.                                                              |
|                  | \$ 1,000                                                                             | \$ 0                                                                                                                                                                                                                                                                                | \$ 1,000                                                                                                                                                                                                                                                         | \$ 4,225                                                                                                                                                                | \$ 1,952                                                                                                                                                                                                                          |
|                  | \$ 500                                                                               | \$ 0                                                                                                                                                                                                                                                                                | \$ 800                                                                                                                                                                                                                                                           | \$ 3,091                                                                                                                                                                | \$ 4,110                                                                                                                                                                                                                          |

## III. Monitored Retrievable Storage (Cont'd):

| Program Activity                                                                                                                                                                                                                                                                                                                                                                                                         | FY 1989  | FY 1990                                                                                                                                                                                                                                                                                                                                                                                                                 | FY 1991                                                                                                                                                                                                                        | FY 1992                                                                                                                                                                                                                         | FY 1993                                                                                                                                                                                                                         |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Project Management</b>                                                                                                                                                                                                                                                                                                                                                                                                |          |                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                |                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                 |
| Initiated Program Management activities. Developed MRS Project Management System, and systems engineering and configuration management program. Developed and implemented a comprehensive quality assurance program that meets DOE and NRC requirements for future licensing. All quality-related activities were planned, scheduled and documented to provide objective evidence of compliance and procedural adequacy. |          | Continue to provide Program Management activities. Develop MRS Project Management System and configuration management program. Begin preparation of life cycle program plan. Begin documentation and reporting as a Major System Acquisition. Maintain a comprehensive quality assurance program that meets DOE and NRC requirements for future licensing. The MRS activities will utilize \$1,520 of prior year funds. | Continue to provide Program Management activities including planning, cost/schedule controls, subcontractor procurement, records management, and configuration management. Maintain a comprehensive quality assurance program. | Continue to provide Program Management and quality assurance activities as in FY 1991.                                                                                                                                          | Continue to provide Program Management and quality assurance activities as in FY 1992. Emphasis will be on management of Title I design activities.                                                                             |
| <b>Systems Support</b>                                                                                                                                                                                                                                                                                                                                                                                                   | \$ 1,750 | \$ 1,500                                                                                                                                                                                                                                                                                                                                                                                                                | \$ 1,900                                                                                                                                                                                                                       | \$ 5,616                                                                                                                                                                                                                        | \$ 5,035                                                                                                                                                                                                                        |
| Funds appropriated for this activity were carried over to FY 1990 due to the extension of due date for submittal of the MRS Review Commission Report to Congress.                                                                                                                                                                                                                                                        |          | Consistent with NUPA Amendments, provide for grants to States, Indian Tribes, or units of local government to assess the feasibility of siting an MRS in their jurisdictions. No funds are requested for benefits payments. If a negotiated, a supplemental budget request will be submitted to provide the required funding. This activity will                                                                        | Consistent with NUPA Amendments, provide for grants to States, Indian Tribes, or units of local government to assess the feasibility of siting an MRS in their jurisdictions. No funds are requested for benefits payments.    | Consistent with NUPA Amendments, provide for grants to States, Indian Tribes, or units of local government for assessing the feasibility of siting an MRS in their jurisdictions. No funds are requested for benefits payments. | Consistent with NUPA Amendments, provide for grants to States, Indian Tribes, or units of local government for assessing the feasibility of siting an MRS in their jurisdictions. No funds are requested for benefits payments. |

### III. Monitored Retrievable Storage (Cont'd):

| Program Activity                 | FY 1989   | FY 1990                                 | FY 1991   | FY 1992   | FY 1993   |
|----------------------------------|-----------|-----------------------------------------|-----------|-----------|-----------|
| .....                            | .....     | .....                                   | .....     | .....     | .....     |
| System Support<br>(Cont'd)       |           | utilize \$1,520 of prior<br>year funds. |           |           |           |
| .....                            | .....     | .....                                   | .....     | .....     | .....     |
|                                  | \$ 5,000  | \$ 0                                    | \$ 1,900  | \$ 7,216  | \$ 10,275 |
| .....                            | .....     | .....                                   | .....     | .....     | .....     |
| Monitored<br>Retrievable Storage | \$ 15,000 | \$ 3,000                                | \$ 10,000 | \$ 69,250 | \$ 45,723 |
| .....                            | .....     | .....                                   | .....     | .....     | .....     |



Senator GRAHAM. Are you saying that within your current financial plan for the permanent repository is contained the funding for this intermediate step?

Mr. BARTLETT. Within our current program plans, as our budget is submitted, we identify essentially, as I indicated earlier, two separate tracks of planning. One is for the repository itself, disposal, with immediate near-term focus, obviously, on the evaluation of the suitability of the Yucca Mountain site.

Independently consistent with the Secretary's restructuring of the program, an identification of 1998 as the target date to begin receiving spent fuel, we have another program track which points at three activities. One is the development and construction and beginning of the MRS facility itself. Second is the related transportation system to make it useful. And the third aspect of that is to develop fully what I call the "spent fuel acceptance system" which completes the logistics for getting the fuel from where it is stored at the reactors into the transportation system and then into the MRS.

So those three go together on the near-term storage objective which is, as I said, the target established by the Secretary to begin receiving in 1998. So in terms of budget, in terms of planning, in terms of program activities—those are separate tracks.

Senator GRAHAM. Given the current difficulties at arriving at a permanent site, what is your level of optimism that we will have greater success in arriving at an MRS before 1998? And what are the consequences of not doing so in 1998, the year in which the Department of Energy is supposed to take title to all this currently stored material?

Maybe—to focus on the first half of that question, what is it that gives us optimism that in eight years we can have an MRS developed—given the history of our last 10 to 20 years of trying to get a permanent site settled—

Mr. BARTLETT. Let me try to address that question, Senator, if I may, taking it in inverse order.

The consequences if we don't have it is obviously that the existing storage capacity at reactors would be strained. We've been discussing some of the factors as to where, how, and to what degree that strain would occur.

Senator GRAHAM. That's focused on the physical restrictions.

Mr. BARTLETT. That's right.<sup>1</sup>

Senator GRAHAM. What about the legal implications? As I understand, the current law says that in 1998 the Department of Energy assumes legal title to the spent fuel. Is that a correct statement?

Mr. BARTLETT. The Nuclear Waste Policy Act, as originally planned, said that the Government would begin receipt of spent fuel on January 31, 1998. Frankly, I'm not sure of the provisions regarding when and how the Department takes the title to the fuel, although I know it does say that. At present, I'm not specific on how it says that.

Senator GRAHAM. Is it your assumption that taking title is also synonymous with taking physical possession?

Mr. BARTLETT. Frankly, at this point, no, it's not an assumption. I simply don't know. I'll have to check that for the record and get back to you on that.

[The following was supplied for inclusion in the record:]

Although taking title is not necessarily synonymous with taking physical possession, the Department will take possession of, and title to, spent nuclear fuel simultaneously, consistent with the provisions of the Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste (10 CFR 961).

Mr. BARTLETT. Now, if I can address the other question that you asked concerning the basis for any confidence that we can begin in 1998—fundamentally, it comes down to two things. First, the fact that in terms of technically and administratively being ready to do so with respect to the program activities and planning for the logistics to be able to have the equipment, have the facilities, have the licenses that would be necessary, et cetera—we anticipate that we can do that. We are planning for that purpose with respect to the transportation system, with respect to the design of the MRS, and with respect to all of the things that will go into assuring the development of a licensed MRS at a given site.

The really key issue, of course, is the timely siting of the MRS through the efforts, principally of the negotiator, which, as I indicated, we will be supporting. The basis for optimism—at least in my mind—with respect to that is that we are taking at this point a very different approach from what was used in the past.

What we are offering, as I previously indicated—or what the Negotiator will be offering—is basically a package of potential activities which include the MRS facility itself, but, in addition, other kinds of things related to the storage function, related to the nuclear fuel cycle, and related to the waste management system, which provide a range of potential socioeconomic benefits to the host State.

Things, such as, for example, operation of the transportation maintenance system or command center, educational programs and facilities, research and development facilities associated with the program, et cetera—all of these would be made available to the potential host State as essentially a menu to be selected from by that potential host so that the State would see, comprehensively, a benefit to being the host for the MRS facility in addition to these other things.

Senator GRAHAM. Senator Reid, it's been suggested that there were similar efforts made with Nevada in terms of trying to make it attractive for Nevada to accept the permanent site provisions or other Federal services or benefits. How would you assess the reaction of Nevada to that proposal?

Senator REID. I can't find a word to describe it. [Laughter.]

Senator GRAHAM. Is the words "enthusiastic reception"?

Senator REID. It was similar to what Senator Simpson referred to earlier. It was a glandular reaction. [Laughter.]

Senator GRAHAM. What is the time schedule for milestones necessary to achieve an MRS by the 1998 date? Let's say, in the calendar year 1991, what will be the most critical decisions to be made if the 1998 date is to be achieved?

Mr. BARTLETT. In the near term, obviously the most critical milestone, Senator, is to achieve an agreement through the efforts of the Negotiator with the potential host State on development of an

agreement for hosting the facility. The timing on that, we would hope, in order to assure that everything else we are planning in support of actually implementing an MRS, is such that we would need to have the agreement concluded between the Negotiator and the host State by no later than approximately mid-calendar 1992.

Approval of that agreement by the Congress we would need no later than the end of calendar 1992. With that schedule, we intend that we could follow through with the implementation, design, licensing, construction, and begin operation.

Senator REID. Mr. Chairman, I wonder if anyone here knows whether the Negotiator is now talking with different States and/or Indian nations regarding this.

Does anybody know?

Senator GRAHAM. Sir, could you identify yourself again, for the record?

Mr. MUSSLER. My name is Robert Mussler. I work in the negotiator's office in Washington, D.C.

We're not prepared to make a statement today, but are in the process of setting up the office, the negotiator was confirmed the first week in August.

Senator REID. The answer must be no.

Senator GRAHAM. Are there any other comments on the MRS question?

If not, I have a final question which is suggested by some earlier questions by Senator Reid.

If the panelists believe that the New Mexico project, the WIPP project, can meet EPA standards, with the possible exception of the problem of human intrusion, then why do you believe that there is a problem with the standards at the Yucca Mountain site? Why is there a problem with the site rather than the standards?

Mr. LOUX. Mr. Chairman, if I might just offer, parenthetically, at the recent symposium that the National Academy conducted earlier this month, several Department of Energy program people associated with Yucca Mountain stated their belief that the EPA standards could be met at Yucca Mountain in some cases by several orders of magnitude, in collusion with the statements by some DOE people that they could be met at WIPP as well and Nevada is sort of asking the same sort of question.

Senator GRAHAM. Is there any more comment on that question?

Mr. BARTLETT. Yes, Mr. Chairman, if I may. I would concur with what Mr. Loux said. It is not appropriate to characterize the concern as whether or not Yucca Mountain would meet the standard at this point because we don't have a sufficient information base. There is too high a degree of uncertainty at this stage about what the properties and characteristics of the Yucca Mountain site are and how they would be relevant to the standards as they would be applied to an evaluation for licensing purposes, and initially, as appropriate to a suitability evaluation.

With that as a basis, let me pick up on a couple of things that have been addressed here earlier—the phrase “juggling numbers” and Senator Simpson's comments about “talking.” Let me, as the potential beneficiary of regulatory largess, in this case, address what those things mean, at least to us as the implementors of the regulation.

In terms of implementation, there are three aspects of regulations that are important to us. One is the regulations themselves, the regulatory standards and the specific provisions. The second is the use of those regulations, the means that are identified for applying the regulations to an evaluation of the licensability of the site or facility, whatever it might be. The third aspect is the actual application of those uses in a license application.

What's going on basically right now is that as we get closer to the specific issues and we can identify them better, as a result of dialogue—for example, as has occurred between the Department and the Nuclear Regulatory Commission concerning the site characterization plan—is that we get a better sense of the substance of the issues associated with regulations and regulatory compliance.

What has become apparent and what is being addressed through things such as the symposium that was held by the National Academy a couple of weeks ago, is something of what the substance of those issues are. It has become clear that there are potential concerns with regard to the regulatory standards themselves and the relationship between those standards and something that has not yet been addressed by the system, the means for implementation of the standards—what can be called “the compliance rules.”

In the case of long term issues of safety, the compliance rules have not yet been addressed. What is being discussed in very arcane terms by those involved in the community is the relationship between the standards and the compliance rules yet to be addressed, and how that can operate effectively so that ultimately the Department has a basis for using those rules with the data we will get from the site in terms of the licensing exercise.

There needs to be talk among the parties involved. That is really what is going on. The symposium that was conducted by the National Academy was, in fact, a talking exercise on some of these issues. Part of it is that some parties are raising questions about stringency of the standards. Then there is the question of the compliance rule-making, yet to be developed, as part of the whole picture.

I would emphasize that that is not juggling numbers. It is interpretation and then coming up with a workable system on the regulatory framework that can be applied appropriately in this case. What we're doing is developing the system, analogous to the system that has been developed for reactor licensing in the past. We're starting that process. We're all learning. As the process of characterizing a site is a process of discovery, what we're embarking on is a process of discovery in terms of what the regulations need to be in order to protect health and safety and to be operable in this system of evaluation.

Senator REID. Mr. Chairman, you can rejugle the words all you want, but words by the man from the Nuclear Regulatory Commission was “juggle the numbers.” That's what he said. So you can juggle the words anyway you want. He said he wanted to “juggle the numbers.” That's what I think is wrong. I think that, as communicated by Doctor Shapiro, that's where the public loses confidence when we start talking about things like “juggling numbers.”

Senator GRAHAM. Doctor Fairhurst.



Mr. FAIRHURST. Doctor Bartlett, I think, has quite neatly summarized what the Academy's position really was. There needs to be talk. There needs to be a dialogue between the various regulatory agencies as to how they're going to implement licensing procedures, et cetera, so that down the road, to get a minimum of litigation, legal action—if the site is technically capable of being safe.

Now, if I may add something to the note about juggling the numbers—we know more now, a lot more, both nationally and internationally because of research done around the world on the nature of the problem that we face in identifying suitable repositories. It was said before that there is only one site in this Country.

These questions are appearing around the world, the same kinds of questions. So it is being learned that maybe some of the things that were established by the NRC, by the EPA, many years ago—by these agencies themselves—need to be revisited because we've learned a lot. We want to give the public the benefit of that knowledge in addition.

So there are things that come up where you may be able to say that you could do that with that and it would give greater safety. That is how I interpret what has been said as "juggling numbers." It's adding formulas, mixing them together, to get a better overall safe repository.

It's not at all a good idea to use an unsafe site.

Senator GRAHAM. Are there any further comments?

[No response.]

Senator GRAHAM. Gentlemen, I wish to express the appreciation of the Committee for your participation today. This has been very illuminating. [Laughter.]

This concludes the three hearings that this Subcommittee will hold this year on the issue of the future of the nuclear power industry. We will reconvene as the 102d Congress in January and continue this pursuit.

Thank you very much.

[Whereupon, at 12:12 p.m., the subcommittee was adjourned, to reconvene at the call of the Chair.]

[Statements submitted for the record follow:]

PREPARED TESTIMONY

SUBMITTED BY

UNITED STATES NUCLEAR REGULATORY COMMISSION

TO

SUBCOMMITTEE ON NUCLEAR REGULATION

COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

UNITED STATES SENATE

CONCERNING

FEDERAL PROGRAM FOR THE DISPOSAL

OF SPENT NUCLEAR FUEL AND HIGH-LEVEL RADIOACTIVE WASTE

PRESENTED BY

ROBERT M. BERNERO

DIRECTOR, OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS

SUBMITTED: OCTOBER 2, 1990

2

Good morning Mr. Chairman, I am Robert M. Bernero, Director of the Nuclear Regulatory Commission's (NRC's) Office of Nuclear Material Safety and Safeguards. I would like to thank you for the opportunity to present the NRC's views on the technical and regulatory issues of importance to a potential geologic repository at the Yucca Mountain site.

First, I would like to give a brief status of the High-Level Waste (HLW) Program from the NRC perspective. Then I will address the specific questions you raised in your September 18, 1990, letter of invitation for this hearing.

In December 1988, the U.S. Department of Energy (DOE) issued the Yucca Mountain Site Characterization Plan (SCP), in preparation for site characterization at the Yucca Mountain site. By the end of July 1989, the NRC staff completed its review of the SCP on schedule and concluded that the plan was usable, but raised two objections to DOE starting work on the site and identified a number of major comments (Attachment 1). The two objections, regarding DOE's quality assurance (QA) program and the Exploratory Shaft Facility (ESF), both stood as obstacles to starting site characterization work. The DOE acknowledged the objections and continued to work toward resolution of the QA objection. Regarding the ESF, further questions were raised by the Nuclear Waste Technical Review Board (NWTRB), and DOE undertook a major study to reevaluate the ESF design. Thus, assuming the acceptable resolution of the QA objection, DOE site characterization might have begun, at least on surface-based testing, and with the priorities recommended by the NRC staff and NWTRB comments. However, the State of Nevada opposed site characterization and has effectively blocked site work for the past year.

NOTE: Attachments to this statement have been retained in committee files.

Fundamental to any safety evaluation of any site is the need to understand the natural system and its potential effects on repository performance regardless of the specific form or numerical values of the EPA and NRC regulations. The purpose of site characterization is to gain this understanding. Therefore, beginning site characterization is largely independent of potential changes to EPA's standard or NRC's regulations.

At the same time that DOE was preparing for site characterization in 1989 and 1990, the U.S. Environmental Protection Agency (EPA) began active work to revise its generic environmental standard for HLW disposal, 40 CFR Part 191, which had been remanded by the Court of Appeals of the First Circuit. NRC proceeded with potential rulemakings and other regulatory guidance activities for HLW disposal. These included interaction with EPA in its effort to modify its HLW standards and preparing NRC regulations to incorporate and implement the resulting EPA standards. These regulatory activities are intended to provide guidance to DOE on what site data will be needed for an adequate license application as well as focusing on reducing regulatory uncertainties. But, as we near the end of 1990, no site characterization is underway.

Now I would like to turn to the specific questions you raised. The views of the NRC staff on DOE's program to characterize the Yucca Mountain site were transmitted to DOE by letter from Robert M. Bernero to Sam Rousso on July 31, 1989. A copy of this letter is attached (Attachment 1). As I mentioned previously, the NRC staff concluded that the SCP was a usable plan, but two objections and many



major concerns were identified. DOE has been making progress toward resolving the NRC staff QA objection by putting an acceptable QA program in place. DOE recently informed NRC that DOE considers six of eight major DOE contractors have QA programs that are acceptable to support initiation of new site characterization activities, subject to certain exceptions. The NRC staff is currently reviewing this DOE conclusion. Further, the DOE and NRC staffs have ongoing interaction to resolve the other concerns contained in Attachment 1.

Regarding the EPA HLW standards, the National Research Council of the National Academy of Sciences (NAS), NRC's Advisory Committee on Nuclear Waste, and the NWTRB have expressed concerns that either the form of EPA's HLW standards or the stringency of those standards might prevent the NRC from reaching a licensing decision regarding an otherwise acceptable HLW repository. EPA is in the process of considering changes to its HLW standards in response to the remand, and the NRC staff is working closely with EPA to refine the standards in ways that would improve implementation.

During the late 1970's and early 1980's, when EPA's standards were under development, the NRC repeatedly voiced its concern regarding the ability to implement the probabilistic format of the standards. Recently, an NRC staff paper, SECY-89-319, (Attachment 2) stated that "a rigorous application of the EPA standards would lead to the conclusion that the standards cannot be implemented in a licensing review." That statement referred to the rigor that would have been required by EPA's 1982 proposed standards. The staff paper went on to explain that EPA had added text to its probabilistic requirements acknowledging the uncertainties involved in predicting repository performance,

and recognizing that judgment would be required by the NRC in evaluating compliance with the standards. In the paper, the staff also stated that "while the language added by EPA to the rule and in the Supplementary Information [in 1985] tends to recognize qualitative considerations, an acceptable approach to implementation is still ambiguous...." More recently, the staff has forwarded comments to EPA on Working Draft No. 2 suggesting alternative wording for EPA's standards in an attempt to address concerns about demonstrating compliance (Attachment 3). We believe that the licensing evaluation will be facilitated if EPA is responsive to our comments.

It is difficult to evaluate the degree of stringency of EPA's HLW standards for two reasons. First, the standards seek to limit the total number of health effects over 10,000 years rather than limiting the risk experienced by an individual. This makes comparisons with more conventional, risk-based standards difficult. Second, EPA has tried to limit repository impacts to the lowest levels reasonably achievable. It is not clear that EPA's analyses of achievability are sufficiently realistic to accommodate the substantial uncertainties that will be encountered in predicting the performance of a real repository. In comments on Working Draft No. 2, the staff identified a need for EPA to "reexamine the stringency of the standard in light of other risks experienced by society and risk levels used as the basis for other safety standards." A clear articulation of the risk basis for the standards is essential to determine whether the standards are overly stringent. The

Commission is reserving judgment at this point on whether we believe the EPA standards are overly stringent, pending a more thorough evaluation of the results of the recent NAS symposium (September 17-18, 1990, Symposium on Radioactive Waste Repository Licensing sponsored by the Board on Radioactive Waste Management (Board) of the National Research Council) as well as EPA's response to our request for an explanation of the risk basis underlying its standard.

One Commissioner and the staff participated in the NAS Symposium on Radioactive Waste Repository Licensing. The Commission has delayed consideration of the conclusions and recommendations in the Board's report entitled "Rethinking High-Level Waste Disposal" in order to give full consideration to the views expressed at the symposium and their import for EPA's and NRC's standards. The Commission will be happy to forward its views on the recommendations of the report when it has completed its deliberations.

STATEMENT OF  
MICHAEL H. SHAPIRO  
DEPUTY ASSISTANT ADMINISTRATOR  
FOR AIR AND RADIATION  
U.S. ENVIRONMENTAL PROTECTION AGENCY  
BEFORE THE  
SUBCOMMITTEE ON NUCLEAR REGULATION  
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS  
U.S. SENATE

OCTOBER 2, 1990

Mr. Chairman and Members of the Subcommittee:

INTRODUCTION

I am Michael H. Shapiro, Deputy Assistant Administrator for Air and Radiation in the Environmental Protection Agency (EPA). I appreciate this opportunity to appear at this hearing to describe the EPA's activities and views in the area of the disposal of spent nuclear fuel and high-level radioactive waste (HLW).

The EPA believes that it is important to proceed with disposal of these wastes in a safe and reasonable manner but only under environmental standards which are protective of human health and the environment and are seen by the public to be stringent enough to ensure confidence that the facilities will be acceptably safe.

DESCRIPTION OF 40 CFR PART 191

The Agency promulgated its Environmental Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes (40 CFR Part 191) on August 15, 1985. These standards were developed pursuant to the Agency's authorities and responsibilities under the Atomic Energy Act of 1954, as amended; Reorganization Plan No. 3 of 1970; and the Nuclear Waste Policy Act of 1982.

The 1985 Standards consisted of two subparts. One subpart limits the annual radiation exposure of individual members of the



public during the management and storage of the subject wastes prior to their disposal. For example, at Department of Energy (DOE) disposal facilities these limits are 25 millirems to the whole body and 75 millirems to any critical organ.

The other subpart established several different types of post-disposal requirements. The primary standards for the period following disposal were long-term containment requirements that limited projected radionuclide releases to the accessible environment for 10,000 years. The Agency estimates that under assumed, generic conditions, these requirements would limit the adverse health impact to no more than ten premature cancer deaths in the first 10,000 years after disposal for each 1,000 metric tons of spent nuclear fuel and HLW or one million curies of alpha-emitting TRU radionuclides. In addition, a set of six qualitative assurance requirements were included to provide added confidence that cautious steps will be taken to reduce problems caused by uncertainties in the quantitative analysis. The third set of requirements limited exposures from all pathways, including drinking water, of individual members of the public for 1,000 years after disposal to 25 millirems per year. Finally, a set of ground-water protection requirements limited, for 1,000 years, radionuclide concentrations in special sources of ground-water to the concentrations allowed by EPA's drinking water standards.

#### LEGAL ACTION CONCERNING 40 CFR PART 191

As you are aware, the disposal requirements have been vacated and remanded to the EPA by the U.S. Court of Appeals for the First Circuit. This is the final outcome of a legal process that began in 1985 when several environmental groups, led by the Natural Resources Defense Council and the States of Maine, Minnesota, Texas, and Vermont filed petitions for review in several Federal courts around the country; these petitions were consolidated in the First Circuit.

The Court rendered its decision in July 1987. That decision vacated and remanded the entirety of the standards even though only the two sections that dealt with individual and ground-water protection requirements, Sections 191.15 and 191.16, respectively, were found defective.

In August 1987, the Justice Department, on behalf of EPA, filed a motion requesting reinstatement of those portions of the Standards which were not found defective. On September 23, 1987, the Court reinstated the management standards, but continued the remand of the disposal standards. The Court thought that all sections of the disposal standards were potentially interconnected and, therefore, changes made on one section could impact another.

**Briefly, the Court concluded that:**

1. disposal of HLW in mined geologic repositories might be underground injection and that EPA failed to consider the Safe Drinking Water Act's (SDWA) requirements on underground injection by potentially allowing endangerment of ground-water by exceeding EPA's own drinking water standards. Therefore, EPA must reconcile the ground-water and individual sections with the SDWA requirements or adequately explain the divergence;

2. EPA must supply an adequate explanation for selecting 1,000 years as the design criterion in the ground-water and individual sections; and,

3. the Ground-Water Protection Requirements were promulgated without proper notice and must be repropose for public comment.

The Agency has initiated a program to re-promulgate the standards. We will propose a rule for public review and comment,

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may emerge as we evaluate comments received on early working drafts of the revised standards. We have placed two working drafts in our public docket, the first in late 1989 and the second in early 1990. While we did not formally request comments the second draft was circulated to interested parties. This process resulted in comments from the Nuclear Regulatory Commission, the Department of Energy, States, the utility industry, and public interest groups. We are also considering views received from last month's National Academy of Sciences' Symposium on Radioactive Waste Repository Licensing to determine if there is new information which warrants further changes.

3. Q: The NRC staff has stated that "a rigorous application of the EPA standards would lead to the conclusion that the standards cannot be implemented in a licensing review." Additionally, the NRC's Advisory Committee on Nuclear Waste (ACNW) has stated that the standards may be unrealistic, are overly stringent, and will be wasteful of resources with little commensurate benefit. Does the EPA agree with the NRC staff or the ACNW? What degree of confidence does the EPA have that compliance with EPA standards can be demonstrated in a licensing proceeding?

A: The concerns of the NRC staff were expressed following proposal of the standards. The Agency subsequently worked with the NRC staff to develop language for the standards to alleviate their concerns. Since there has been considerable concern expressed regarding the stringency and the implementability of the standard, a brief discussion of both the risk objective underlying the standard and our view of how the standard should be implemented is warranted.

taking into account the issues raised by the Court. Based upon the comments received, we will then proceed to reissue the standards, incorporating any revisions that prove to be appropriate.

**ADVANCE QUESTIONS FROM THE SUBCOMMITTEE**

At this time I would like to address the questions specifically raised by the subcommittee.

1. Q: What is the EPA's schedule for the issuance of revised environmental standards for the disposal of spent nuclear fuel and high-level radioactive wastes?

A: The most recent schedule for the reissuance of the standards calls for proposal to occur early in 1991 followed by hearings later in 1991 and a final rule to be promulgated in 1992. Based on a recent National Academy of Sciences meeting and comments from the Advisory Committee on Nuclear Waste, we are evaluating the need to consider additional options for proposal. This may delay the schedule by two to three months.

2. Q: Which of the standards is the EPA planning to revise?

A: EPA is planning minor changes in many sections of the standards due, in some cases, to a need for clarification of some points and, in other cases, changes in technical nomenclature since 1985.

The most significant changes from the 1985 standards that are being considered are in the ground-water protection provisions, the area where the Court was most critical. Also, options are being considered in some of the other sections. As directed by the Court, our major focus has been the ground-water provisions. It is possible that some additional options

**Stringency of 40 CFR Part 191**

The containment requirements in the 1985 standards were designed to limit the total projected release of specific radionuclides over a 10,000-year period after disposal. The basis of this requirement came from EPA's examination of current disposal technology and several geologic media. The Agency began by evaluating the capability of mined geologic repositories to isolate wastes from the environment. Potential radionuclide releases over 10,000 years were evaluated, and very general models of environmental transport were used to relate these releases to the incidence of premature cancer deaths they might cause. The reference cases, after adjustments based on the Science Advisory Board's recommendations, estimated the number of fatal cancer deaths to be from about 10 to about 200. Realizing that the models used in these assessments were relatively simple and to accommodate some of the uncertainties inherent in such assessments, the estimate was adjusted to 1,000.

In order to gain some perspective on how the health risks associated with these disposal technologies compare with natural analogues, the Agency evaluated the health risks that future generations would be exposed to from the amount of uranium ore needed to produce 100,000 metric tons of reactor fuel, if this ore had never been mined. The estimates of the risk ranged from about 10 to more than 100,000 fatal cancer deaths over 10,000 years. This large range is due to the fact that the study looked at existing ore bodies with their varying sizes, ground-water chemistries, and difficulties in measuring uranium solubility which can vary by several orders of magnitude.

This analysis reinforced the Agency's conclusion that limiting radionuclide releases to levels associated with no more than 1,000 premature cancer deaths over 10,000 years from



disposal of the wastes from 100,000 metric tons of reactor fuel is an appropriate risk objective.

In summary, the risk level implied by the 1985 standards appear reasonably achievable by the technology being considered for nuclear waste disposal. In addition, the Agency believed that such a limitation would limit risks to future populations to acceptably small levels, in light of the range of estimated risks that future generations would have been exposed to if the uranium ore used to create the wastes had never been mined.

Another factor which influenced the Agency was public opinion expressed during the various phases of the original rulemaking. This opinion emphasized that the uncertainties involved in the long-term disposal of high-level and transuranic radioactive wastes justify conservatism in the standard and that a loss of confidence in the program could follow if the risk goals were relaxed from the levels in the proposed standards.

#### Implementability of 40 CFR Part 191

Given the nature of the task at hand--that is, developing regulations to assess and ensure the long-term (i.e., 10,000+ years) safety and performance of nuclear waste disposal facilities--we can certainly appreciate the concerns some have expressed regarding the implementability of the EPA standards. The challenge lies in producing a standard that does not preclude or stifle the development of disposal systems and that ensures that those which are developed will be protective of human health and the environment.

We are aware that there is no way to make predictions over 10,000 years and have total certainty as to their

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accuracy. In fact, we expect a good deal of uncertainty. We dealt with this uncertainty by indicating in our 1985 standard that the analysis needs to show only a "reasonable expectation" that the standards would be met. We purposefully avoided using the term "reasonable assurance" because it has been used extensively in the licensing of nuclear reactors and has acquired stricter connotations than we believed are appropriate to apply to a waste repository. We did not develop a quantitative definition for "reasonable expectation" because we believed that it was both premature and partly the responsibility of the NRC in its licensing process. We expected human judgment to be involved and we accepted that there is no way to prove the absolute accuracy of the models upon which we must rely.

It is worth noting that early performance assessments conducted for the Department of Energy on the Waste Isolation Pilot Plant facility in southeastern New Mexico, show "reasonable confidence that compliance with the Standard is achievable." (See Sandia Status Report: Potential for Long-Term Isolation by the WIPP Disposal System June 1990.)

Q: What are the EPA's views on the conclusion of the National Research Council of the National Academy of Sciences (NRC/NAS) that "the U.S. program, as conceived and implemented over the past decade, is unlikely to succeed?"

A: There is no doubt that the country has set for itself a considerable challenge in seeking to establish a high-level radioactive waste repository. In our evaluation of the regulatory aspects of this issue we do not see the system as broken beyond repair. We believe that it is more appropriate for DOE, as program manager, to comment on the likelihood of success of the current program. We believe that our original

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1985 standards would be implementable and we anticipate that any changes resulting from our revised regulation, based on comments to date, will result in regulations that support the development of a high-level waste disposal program that is technologically sound and protective of human health.

We recognize that flexibility is necessary to address unforeseen circumstances and we believe that the regulatory system allows such flexibility.

5. Q: More specifically, what are the EPA's views on each of the recommendations of the report (pages 31 and 32 of the report)?

A: Our views are as follows:

"1. It may be appropriate to delay repository development."

We believe this recommendation is best addressed by the Department of Energy. However, we do not see our rulemaking as a significant delay factor in light of the present schedule.

"2. EPA should reconsider the underlying risk objective of 40 CFR 191, i.e., the radionuclide release limit criteria, and the feasibility of a dose-only standard."

We are reconsidering all parts of the standards and intend to further clarify the Agency's intention as to a reasonable level of assurance. We are not persuaded that a dose-only requirement is either sufficient or practical to implement over a 10,000-year time span. We are, however, still reviewing this issue.

"3. The NRC should reconsider its repository licensing requirements."

We believe this recommendation is best addressed by NRC.

"4. The DOE should continue and expand its efforts to become a more responsive player in regulatory issues.

5. The DOE should make greater use of conservative engineering design.

6. The DOE should participate more actively in international studies and forums."

We believe these recommendations are best addressed by the Department of Energy.

"7. Contingency planning for other nuclear waste disposal sites and technologies should be pursued."

Congress has clearly set geologic disposal as the primary option to be investigated. However, the EPA agrees with the Academy that contingency planning by exploring alternative disposal methods is a prudent precaution.

Mr. Chairman, that concludes my prepared statement. I would be pleased to answer any questions the Subcommittee may have.

Statement of Don U. Deere

Chairman

Nuclear Waste Technical Review Board

before the

Subcommittee on Nuclear Regulation

Committee on Environment and Public Works

United States Senate

October 2, 1990



Mr. Chairman and Members of the Subcommittee:

I am Don U. Deere, Chairman of the Nuclear Waste Technical Review Board (the Board). On behalf of the entire Board, I would like to thank you and the Subcommittee on Nuclear Regulation, Committee on Environment and Public Works, United States Senate, for the opportunity to present our current views on the disposal of high-level radioactive waste (HLW), which includes spent nuclear fuel.

#### Background on the Board

The Board was established in the Nuclear Waste Policy Amendments Act of 1987 to evaluate the technical and scientific validity of the Department of Energy's (DOE) commercial radioactive waste management program. This broad charge includes the evaluation of activities related to the characterization of the candidate site for HLW disposal at Yucca Mountain, Nevada, and to the transportation and packaging of HLW.

The Board currently has seven internal working panels: Structural Geology & Geoengineering, chaired by Dr. Clarence Allen; Hydrogeology & Geochemistry, chaired by Dr. Donald Langmuir; Engineered Barrier System, chaired by Dr. Ellis Verink; Transportation & Systems, chaired by Dr. Dennis Price; Environment and Public Health, chaired by Dr. Melvin Carter; Risk & Performance Analysis, chaired by Dr. D. Warner North; and Quality Assurance, chaired by Dr. John Cantlon. A total of 17 panel meetings and technical exchanges have been held over the last 19 months. The full Board has met 10 times.

At full strength the Board will have 11 members, who are nominated by the National Academy of Sciences and appointed by the President. To date, nine members have been appointed to the Board. The Board, which met for the first time in

March 1989, two months after the first appointments, reports to the U.S. Congress and the Secretary of Energy at least twice a year. Its *First Report* was published in March 1990; the second report is scheduled for publication in mid-November.

### Introduction

The disposal of HLW has been an issue of long-standing importance. In 1955, the National Academy of Sciences (i.e., the Committee on Earth Sciences of its National Research Council) first examined the problems associated with the disposal of HLW. At the time, it recommended permanent isolation of the waste in mined geological formations. This basic approach for disposal is still being pursued by the United States. There is currently a worldwide scientific consensus that a deep geologic repository is the best option for the disposal of HLW.

The development of a geologic repository is a complex undertaking. First, it involves scientific and technical challenges in many diverse areas. These areas include evaluating the geologic characteristics of potential repository sites, assessing the effectiveness of natural geologic and engineered barriers to radionuclide migration, designing the repository with its engineered barriers, and coping with the inevitable uncertainties involved in predicting repository performance for at least 10,000 years.

Second, there needs to be assurance that over this time period the HLW will not pose a threat to public health and the environment. Therefore, standards and regulations have to be developed that, if met, would provide such assurance. The HLW management program needs, in turn, to demonstrate in a licensing proceeding that any repository complies with these standards.

Finally, waste management decisions are made substantially more difficult by nontechnical and political problems. Waste management activities are inevitably conducted in an arena where there is considerable public interest and apprehension

about anything related to nuclear energy and radiation. Most localities don't want nuclear facilities sited in their "backyards." There also are many groups with diverse but special interests involved in HLW management. These include the public, the utilities, various environmental and public interest groups, Indian Tribes, state and local governments, and all three branches of the federal government.

### Findings

The Board believes that there are no insurmountable technical reasons why an acceptable deep geologic repository cannot be developed. The Board also believes that an appropriate regulatory framework to protect the public and the environment should be based on sound scientific and technical considerations. Finally, the Board recognizes that substantial amounts of time and resources will be required to resolve emerging nontechnical as well as technical issues.

The Board's testimony will focus on three topics: (1) technical aspects of maximizing waste isolation, (2) regulatory improvements, and (3) nontechnical siting problems.

#### 1. Technical aspects of maximizing waste isolation.

The current concept of geologic disposal involves using multiple barriers to isolate HLW from the accessible environment for at least 10,000 years. The proposed repository will consist of both natural geologic barriers and man-made, engineered barriers that together will contain the HLW. The overall uncertainty about a repository's long-term performance can be reduced by using redundant engineered barriers in addition to natural geologic barriers. Engineered barriers should be designed to contain the HLW for as long as reasonably possible. The Board believes that such a concept for a geologic repository is technically sound.

The Board believes that current science and technology make possible the development of improved engineered barriers. Our knowledge of metallurgy, materials science, and geochemistry is adequate for the development of long-lived containers and waste packages. Alternate emplacement configurations—along with knowledge of the geologic, hydrologic, and thermal environment—may maximize the waste isolation properties of the waste package.

Because of past ambiguities in the NRC's regulations, long-lived waste packages and other types of engineered barriers have not been used to their maximum extent by the DOE in current repository designs. However, the Board believes that a full range of waste packages and other engineered barriers should be seriously considered. According to a staff position paper issued by the NRC in July 1990, the DOE may use and receive licensing credit for any long-lived waste packages designed for greater than 1,000 years.

Improved engineered barriers can, in our judgment, make a substantial contribution to waste isolation and increase our overall confidence in the ability of the repository to meet its goals. The Board has recommended that the DOE investigate further the advantages and disadvantages associated with the use of long-lived engineered barriers.

## 2. Regulatory improvements.

Our regulatory framework should provide assurance that a repository will, in fact, isolate HLW. Finding a repository site that is judged to be suitable is but one step in the regulatory process. The repository design—incorporating natural geologic and engineered barriers—must also comply with our standards and regulations. The Board believes that the regulatory framework should be sufficiently conservative to fully protect public health and the environment. But it should not be so restrictive as to foreclose at the outset the use of repository sites that can be shown to be suitable on the basis of sound scientific and technical considerations.

The Environmental Protection Agency (EPA) and the Nuclear Regulatory Commission (NRC), respectively, have developed standards and regulations that affect site-characterization activities as well as the design, construction, and operation of geologic repositories. However, many in the technical community are currently concerned about our ability to construct and license a repository in accordance with present federal standards and regulations. These guidelines have been criticized as being too stringent and prescriptive; others as too ambiguous or simply inappropriate for geologic repositories.

The Board detailed several concerns about the EPA Standard, 40 CFR 191, in its *First Report to the U.S. Congress and the U.S. Secretary of Energy*. Specifically, the Board questioned the conservatism of the Standard, as contained in Section 191.13 and illustrated by the numerical limits contained in Table 1, Appendix B. The Board recommended that those limits be re-evaluated in light of current environmental and regulatory requirements. A re-evaluation of the Standard should also consider the doses that the general population receives from routine exposures and natural sources of radiation. The Board also believes that the concept "as low as reasonably achievable" (ALARA) may be inappropriate for a repository. Other changes also could be made to clarify the Standard.

In making these recommendations the Board joined many other groups that have similar, and sometimes broader, concerns about our present regulatory framework. These groups include the Subcommittee on Waste Management of the NRC's Advisory Committee on Reactor Safety, the NRC's Advisory Committee on Nuclear Waste Management, the National Research Council's Board on Radioactive Waste Management, and various environmental and public interest groups.

The Board believes that the current regulatory framework can be improved. With such improvements, a candidate site, judged to be technically suitable, can also be licensed. In recent letters to William Reilly, the Administrator of EPA, and



Kenneth Carr, the Chairman of the NRC, we have suggested that the EPA and the NRC enter jointly into negotiated rulemaking on 40 CFR 191 and 10 CFR 60.

### 3. Nontechnical siting problems.

Any candidate site for repository development must undergo both surface and underground characterization before its suitability can be completely determined. Early evaluation of the suitability of the Yucca Mountain Site has been and continues to be a prime concern of the Board. However, the DOE's efforts to characterize the Yucca Mountain Site are presently constrained by the State of Nevada's refusal to issue the necessary state permits. Much of this state opposition is in direct response to the perceived manner in which the Yucca Mountain Site was chosen for characterization by the Congress in 1987. The recent court decision should bring us closer to site characterization.

Site characterization is an essential phase in determining the suitability of the candidate site for repository development. Any delays in site characterization will result in comparable delays in arriving at a judgment about site suitability.

### Concluding remarks about the DOE's program

Managing HLW poses technical, regulatory, and institutional challenges. Within this context, the Board sees progress by the DOE in implementing its HLW management program. In November 1989, the Secretary of Energy issued a comprehensive report to the Congress refocusing the program. The Board believes that the changes in programmatic schedules reflect a more realistic appraisal of the complexities of waste management activities. In April 1990, Dr. John Bartlett was appointed director of the DOE's Office of Civilian Radioactive Waste Management. One month later, Dr. Bartlett announced the development of a new management plan. In June, David H. Leroy was appointed nuclear waste negotiator to facilitate the siting of facilities for interim storage

appointed nuclear waste negotiator to facilitate the siting of facilities for interim storage and permanent disposal of HLW. These are all positive steps; however, the ultimate results of these changes can only be judged over time.

The DOE and its representatives have been very responsive to the Board in providing requested information, organizing meetings, and addressing Board concerns. We are generally pleased with the DOE's good-faith efforts to address the recommendations that the Board made in its *First Report*. This is particularly the case with respect to the need for additional underground exploration, prioritization of testing to determine site suitability, and the iterative use of performance assessment. As the DOE's program progresses, the NWTRB will continue to fulfill its congressionally mandated responsibilities of monitoring ongoing DOE activities.

Mr. Chairman that concludes my prepared remarks. I would be pleased to address any questions that you or any of the other subcommittee members may have.

NATIONAL RESEARCH COUNCIL  
COMMISSION ON GEOSCIENCES, ENVIRONMENT, AND RESOURCES  
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October 2, 1990

Comments of Charles Fairhurst  
before the  
Subcommittee on Nuclear Regulation  
of the  
Committee on Environment and Public Works  
Dirksen Senate Office Building 406  
Washington, DC 20510

The attached is a copy of the publication "Rethinking High-Level Radioactive Waste Disposal" by the Board on Radioactive Waste Management of the National Academy of Sciences. "Rethinking" represents the best summary available of the views of the Board, and is the basis for Charles Fairhurst's comments at the Subcommittee's October 2 hearing on the federal program for the disposal of spent nuclear fuel and high-level radioactive waste. "Rethinking" contains three levels of detail: abstract, summary, and the full report. At the hearing, Dr. Fairhurst, Vice-Chairman of the Board, will present a five-minute synthesis of the report.

**RETHINKING HIGH-LEVEL RADIOACTIVE WASTE DISPOSAL**

**A Position Statement  
of the Board on Radioactive Waste Management**

Commission on Geosciences, Environment, and Resources  
National Research Council

NATIONAL ACADEMY PRESS  
Washington, D.C. July 1990

NOTICE: The project that is the subject of this report was approved by the Governing Board of the National Research Council, whose members are drawn from the councils of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. The members of the committee responsible for the report were chosen for their special competences and with regard for appropriate balance.

This report has been reviewed by a group other than the authors according to procedures approved by a Report Review Committee consisting of members of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

The National Academy of Sciences is a private, nonprofit, self-perpetuating society of distinguished scholars engaged in scientific and engineering research, dedicated to the furtherance of science and technology and to their use for the general welfare. Upon the authority of the charter granted to it by the Congress in 1863, the Academy has a mandate that requires it to advise the federal government on scientific and technical matters. Dr. Frank Press is president of the National Academy of Sciences.

The National Academy of Engineering was established in 1964, under the charter of the National Academy of Sciences, as a parallel organization of outstanding members, sharing with the National Academy of Sciences the responsibility for advising the federal government. The National Academy of Engineering also sponsors engineering programs aimed at meeting national needs, encourages education and research, and recognizes the superior achievements of engineers. Dr. Robert M. White is president of the National Academy of Engineering.

The Institute of Medicine was established in 1970 by the National Academy of Sciences to secure the services of eminent members of the appropriate professions in the examination of policy matters pertaining to the health of the public. The Institute acts under the responsibility given to the National Academy of Sciences by its congressional charter to be an adviser to the federal government and, upon its own initiative, to identify issues of medical care, research, and education. Dr. Samuel O. Thier is president of the Institute of Medicine.

The National Research Council was organized by the National Academy of Sciences in 1916 to associate the broad community of science and technology with the Academy's purposes of furthering knowledge and advising the federal government. Functioning in accordance with general policies determined by the Academy, the Council has become the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering in providing services to the government, the public, and the scientific and engineering communities. The Council is administered jointly by both Academies and the Institute of Medicine. Dr. Frank Press and Dr. Robert M. White are chairman and vice chairman, respectively, of the National Research Council.

The material summarized in this report was the product of a July 1988 retreat sponsored by the Board on Radioactive Waste Management and was supported by the U.S. Department of Energy under Contract No. DE-AC01-86DP48039.

Copies of this report are available in limited supply from:

Board on Radioactive Waste Management  
National Research Council  
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Printed in the United States of America



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## ABSTRACT

There is a worldwide scientific consensus that deep geological disposal, the approach being followed in the United States, is the best option for disposing of high-level radioactive waste (HLW). There is no scientific or technical reason to think that a satisfactory geological repository cannot be built. Nevertheless, the U.S. program, as conceived and implemented over the past decade, is unlikely to succeed.

For reasons rooted in the public's concern over safety and in the implementing and regulatory agencies' need for political credibility, the U.S. waste disposal program is characterized by a high degree of inflexibility with respect to both schedule and technical specifications. The current approach, in which every step is mandated in detail in advance, does have several advantages:

- it facilitates rigorous oversight and technical auditing;
- its goals and standards are clear;
- it is designed to create a sense of confidence in the planning and operation of the repository; and
- if carried out according to specifications, it is robust in the face of administrative or legal challenge.

This approach is poorly matched to the technical task at hand. It assumes that the properties and future behavior of a geological repository can be determined and specified with a very high degree of certainty. In reality, however, the inherent variability of the geological environment will necessitate frequent changes in the specifications, with resultant delays, frustration, and loss of public confidence. The current program is not sufficiently flexible or exploratory to accommodate such changes.

The Board on Radioactive Waste Management is particularly concerned that geological models, and indeed scientific knowledge generally, have been inappropriately applied. Computer modeling techniques and geophysical analysis can and should have a key role in the assessment of long-term repository isolation. In the face of public concerns about safety, however, geophysical models are being asked to predict the detailed structure and behavior of sites over thousands of years. The Board believes that this is scientifically unsound and will lead to bad engineering practice.

The United States appears to be the only country to have taken the approach of writing detailed regulations before all of the data are in. As a result, the U.S. program is bound by requirements that may be impossible to meet. The Board believes, however, that enough has been learned to formulate an approach that can succeed. This alternative approach emphasizes flexibility: time to assess performance and a willingness to respond to problems as they are found, remediation if things do not turn out as planned, and revision of the design and regulations if they are found to impede progress toward the health goal already defined as safe disposal. To succeed, however, this alternative approach will require significant changes in laws and regulations, as well as in program management.

## SUMMARY

Since 1955, the National Research Council (NRC) has been advising the U.S. government on technical matters related to the management of radioactive waste. Today, this advice is provided by the Board on Radioactive Waste Management (BRWM or "the Board"), a permanent committee of the NRC. The conclusions presented in this position statement are the result of several years of discussions within the Board, whose members possess decades of professional experience in relevant scientific and technical fields.

In July 1988, the Board convened a week-long study session in Santa Barbara, California, where experts from the United States and abroad joined BRWM in intensive discussions of current U.S. policies and programs for high-level radioactive waste management. The group divided its deliberations into four categories: (1) the limitations of analysis; (2) moral and value issues; (3) modeling and its validity; and (4) strategic planning. A summary of the findings of these discussions, from which this position statement has been developed, follows the Summary.

### Current U.S. Policy and Program

In the Nuclear Waste Policy Act of 1982 (NWPA), Congress assigned responsibility to the Department of Energy (DOE) for designing and eventually operating a deep geological repository for high-level radioactive waste (HLW). The repository must be licensed by the U.S. Nuclear Regulatory Commission (USNRC) and must meet radionuclide release limits, based on a generic repository, that would result in less than 1000 deaths in 10,000 years as specified in a Standard established by the Environmental Protection Agency (EPA) (40 CFR 191).

The U.S. program is unique among those of all nations in its rigid schedule, in its insistence on defining in advance the technical requirements for every part of the multibarrier system, and in its major emphasis on the geological component of the barrier as detailed in 10 CFR 60. Because one is predicting the fate of the HLW into the distant future, the undertaking is necessarily full of uncertainties. In this sense the government's HLW program and its regulation may be a "scientific trap" for DOE and the U.S. public alike, encouraging the public to expect absolute certainty about the safety of the repository for 10,000 years and encouraging DOE program managers to pretend that they can provide it.

For historical and institutional reasons, DOE managers tend to feel compelled to do things perfectly the first time, rather than to make changes in concept and design as unexpected geological features are encountered and as scientific understanding develops. This "perfect knowledge" approach is unrealistic, given the inherent uncertainties of this unprecedented undertaking, and it runs the risk of encountering "show-stopping" problems and delays that could lead to a further deterioration of public and scientific trust. Today, because of the regulatory requirements and the way the program is being

carried out, U.S. policy has not led to satisfactory progress on the problem of radioactive waste disposal.

### Scientific Consensus on Geological Isolation

There is a strong worldwide consensus that the best, safest long-term option for dealing with HLW is geological isolation. High-level waste should be put into specially designed and engineered facilities underground, where the local geology and groundwater conditions have been chosen to ensure isolation of the waste for tens of thousands of years or longer, and where waste materials will migrate very slowly if they come into contact with the rock.

Although the scientific community has high confidence that the general strategy of geological isolation is the best one to pursue, the challenges are formidable. In essence, geological isolation amounts to building a mine in which "ore" will be put back into the ground rather than taken out. Mining, however, has been and remains fundamentally an exploratory activity: because our ability to predict rock conditions in advance is limited, miners often encounter surprises. Over the years, mining engineers have developed methods to deal with the vagaries of geological environments, so that mineral extraction and construction can continue safely even when the conditions encountered are different from those anticipated.

It is at this point that geological isolation of radioactive waste differs in an important sense from mining. In the United States, radioactive waste management is a tightly regulated activity, surrounded by laws and regulations, criteria and standards. Some of these rules call for detailed predictions of the behavior of the rock for the tens of thousands of years that the radioactive materials are to be isolated.

Preparing quantitative predictions so far into the future stretches the limits of our understanding of geology, groundwater chemistry and movement, and their interactions with the emplaced material (radioactive waste package, backfill, sealants, and so forth). Although the basic scientific principles are well known, quantitative estimates (no matter how they are obtained) must rely on many assumptions. As a consequence, the resulting estimates are uncertain to some degree, and they will remain uncertain no matter how much additional information is gathered.

### Treatment of Uncertainty

The character and implications of these uncertainties must be clearly understood by political leaders, program managers, and the concerned public. Engineers and scientists, no matter how experienced or well trained, are unable to anticipate all of the potential problems that might arise in trying to site, build, and operate a repository. Nor can science "prove" (in any absolute sense) that a repository will be "safe" as defined by EPA standards and USNRC regulations. This is so for two reasons.

First, proof in the conventional sense cannot be available until we have experience with the behavior of an engineered repository system—precisely what we are trying to predict. The existence of uncertainties has prompted efforts to improve the technical analysis, but there will always remain some residual uncertainty. It is important to

recognize, however, that uncertainty does not necessarily mean that the risks are significant. What it does mean is that a range of results are possible, and a successful management plan must accommodate residual uncertainties and still provide reasonable assurance of safety.

Second, safety is in part a social judgment, not just a technical one. How safe is safe enough? Is it safer to leave the waste where it is, mostly at reactor sites, or to put it in an underground repository? In either case safety cannot be 100 percent guaranteed. Technical analyses can provide background for answering such questions, but ultimately the answers depend on choices made by the citizens of a democratic society. The EPA has not based its standards (which must allow for these choices by the citizenry) on social judgments derived from realistic consideration of these alternatives. Both of these important limitations of the analysis have been understated.

The federal government must provide full public accountability as information about the risks changes with experience. This is not an impossible task: government and business make decisions every day under similar conditions of uncertainty. But a policy that promises to anticipate every conceivable problem, or assumes that science will shortly provide all the answers, is bound to fail.

The public has been told too often that absolute guarantees can be provided, but most citizens watching the human frailties of their governments and technologists know better. A realistic--and attainable--goal is to assure the public that the likelihood of serious unforeseen events (serious enough to cause catastrophic failure in the long term) is minimal, and that the consequences of such events will be limited. These assurances rest on the credible application of general principles, rather than a reliance on detailed predictions.

### Modeling of Geological Processes

The current U.S. approach to developing a geological repository (with a mandated 10,000-year lifetime) for radioactive waste is based on a regulatory philosophy that was developed from the licensing of nuclear power plants (which have a nominal 40-year lifetime). The geological medium, however, cannot be specified in advance to the degree possible for man-made components, such as valves or electronic instruments, nor can it be tested over its projected lifetime as can many man-made components. Commercial mining and underground construction both operate on the sound principle of "design (and improve the design) as you go." The inherent variability of the geological environment necessitates changes in specifications as experience increases. If that reality is not acknowledged, there will be unforeseen delays, rising costs, frustration among field personnel, and loss of public confidence in the site and in the program.

Models of the repository system are useful, indeed indispensable. The computerized mathematical models that describe the geological structure and hydrological behavior of the rock are needed to manage the complex calculations that are necessary to evaluate a proposed site. Models are vital for two purposes: (1) to understand the history and present characteristics of the site; and (2) to predict its possible future behavior. Putting the available data into a coherent conceptual framework should focus attention on the kinds of uncertainty that persist. For example, the modeling of groundwater flow through fractured rock lies at the heart of understanding whether and how a repository



in hard rock will perform its essential task of isolating radioactive materials. The studies done over the past two decades have led to the realization that the phenomena are more complicated than had been thought. Rather than decreasing our uncertainty, this line of research has increased the number of ways in which we know that we are uncertain. This does not mean that science has failed: we have learned a great deal about these phenomena. But it is a commonplace of human experience that increased knowledge can lead to greater humility about one's ability to fully understand the phenomena involved.

Uncertainty is treated inappropriately in the simulation models used to describe the characteristics of the waste repository. As the quantity of information about natural geological settings grows, so too does our appreciation of their variability and unpredictability. This distinction has often been ignored. Indeed, the very existence of large databases and sophisticated computer models suggests, erroneously, that it is appropriate to design a geological repository as if it were a nuclear power plant or jet airliner, both of which have predictable attributes over their short lifetimes. That assumption of accurate predictability will continue to produce frustration and failure. Under the present program models are being asked to provide answers to questions that they were not designed to address. One scientifically sound objective of geological modeling is to learn, over time, how to achieve reasonable assurance about the long-term isolation of radioactive waste. That objective is profoundly different from predicting quantitatively the long-term behavior of a repository. Yet, in the face of public concerns about the safety of HLW disposal, it is the latter use to which models have been put.

The Board believes that this use of geological information and analytical tools--to pretend to be able to make very accurate predictions of long-term site behavior--is scientifically unsound. Its conclusion is based on detailed reviews of the methods used by the DOE and the regulatory agencies in implementing the NWPA.

Well-known geophysical principles can be used to estimate or to set bounds on the behavior of a site, so that its likely suitability as a waste repository can be evaluated. But it is inappropriate to stretch the still-incomplete understanding of a site into a quantitative projection of whether a repository will be safe if constructed and operated there. Only after a detailed and costly examination of the site itself can an informed judgment be reached, and even then there will still be uncertainties.

Many of the uncertainties associated with a candidate repository site will be technically interesting but irrelevant to overall repository performance. Further, the issues that are analytically tractable are not necessarily the most important. The key task for performance modeling is to separate the significant uncertainties and risks from the trivial. Similarly, when there are technical disputes over characteristics and processes that affect calculations of waste transport, sensitivity analysis with alternative models and parameters can indicate where further analysis and data are required and where enough is known to move on to other concerns.

It may even turn out to be appropriate to delay permanent closure of a waste repository until adequate assurances concerning its long-term behavior can be obtained through continued in-site geological studies. Judgments of whether enough is known to proceed with placement of waste in a repository will be needed throughout the life of the project. But these judgments should be based on a comparison of available alternatives, rather than a simplistic debate over whether, given current uncertainties, a

repository site is "safe." Even while the detailed, long-term behavior of an underground repository is still being studied, it may be marginally safer to go ahead and store reactor waste there (in a way that permits retrieval if necessary), rather than leaving it at reactors.

As a rule, the values determined from models should only be used for comparative purposes. Confidence in the disposal techniques must come from a combination of remoteness, engineering design, mathematical modeling, performance assessment, natural analogues (see below), and the possibility of remedial action in the event of unforeseen events. There may be political pressure on implementing agencies to provide absolute guarantees, but a more realistic--and attainable--goal is to assure the public that the likelihood of unforeseen events is minimal, and that the magnitude of the consequences of such events is limited. Such an alternative approach, now being used in Canada and Sweden, promises to be far more successful in achieving a safe and practical waste disposal system.

### Moral and Ethical Questions

Radioactive waste poses hazards that raise moral and ethical concerns. First, some of the radioactivity lasts for extremely long periods of time--the EPA standard for HLW calls for isolation of the waste for 10,000 years and more, a time longer than recorded human history. Second, the risks of high-level waste will be concentrated at a very few geological repositories. The neighbors of proposed waste repositories have understandably been alarmed at the prospect of hosting large quantities of a material that needs to be handled with great care. Ethical studies in this area underscore two points: (1) the central role of a fair process; and (2) the pervasive problem of promising more certainty than can be delivered.

The need for a fair process is simply stated: people feel threatened by radioactive waste; and they deserve to be taken seriously in the decision-making process. The sense of threat is often ill informed, in a narrow technical sense; but when that occurs, it is the duty of technical experts and program managers to provide information and employ analyses that will be credible to the affected populations. Only with valid information that they believe can those affected parties negotiate equitable solutions. The primary goal of the program is to provide safe disposal; a secondary goal is to provide it without any gross unfairness. As a result, the mechanisms of negotiation, persuasion, and compensation are fundamental parts of any program to manage and dispose of radioactive waste--not mere procedural hoops through which program managers must jump.

The second ethical point is also important: the demand for accountability in our political system has fostered a tendency to promise a degree of certainty that cannot be realized. Pursuing that illusory certainty drives up costs without delivering the results promised or comparable benefits. The consequence is frustration and mistrust. For example, it is politically costly to admit that one has been surprised in exploring sites being considered for HLW repositories. Yet, this situation is self-defeating: surprises are bound to occur because a principal reason for exploration is to discover what is there.

Instead of pursuing an ever-receding mirage, it is sensible to pursue an empirical exploratory approach: one that emphasizes fairness in the process while seeking outcomes that the affected populations judge to be equitable in light of their own values. This is not an easy course, but it is necessary.

### **An Alternative Approach**

There are scientific reasons to think that a satisfactory HLW repository can be built and licensed. But for the reasons described earlier, the current U.S. program seems unlikely to achieve that desirable goal. The Board proposes an alternative approach that is built on well-defined goals and objectives, utilizes established scientific principles, and can be achieved in stages with appropriate review by regulatory and oversight bodies and with demonstrated management capabilities. The Board suggests an institutional approach that is more flexible and experimental—in other words, a strategy that acknowledges the following premises:

- Surprises are inevitable in the course of investigating any proposed site, and things are bound to go wrong on a minor scale in the development of a repository.
- If the repository design can be changed in response to new information, minor problems can be fixed without affecting safety, and major problems, if any appear, can be remedied before damage is done to the environment or to public health.

This flexible approach can be summarized in three principles:

- Start with the simplest description of what is known, so that the largest and most significant uncertainties can be identified early in the program and given priority attention.
- Meet problems as they emerge, instead of trying to anticipate in advance all the complexities of a natural geological environment.
- Define the goal broadly in ultimate performance terms, rather than immediate requirements, so that increased knowledge can be incorporated in the design at a specific site.

In short, this approach uses a scientific approach and employs modeling tools to identify areas where more information is needed, rather than to justify decisions that have already been made on the basis of limited knowledge.

The principal virtue of this strategy is that it would use science in the proper fashion. It would be similar to the strategies now being followed in Canada and Sweden, where the exploration and construction of an underground test laboratory and a shallow underground low-level waste repository have followed a flexible path. At each step, information and understanding developed during the prior stages are combined with experience from other underground construction projects, in order to modify designs and procedures in light of the growing stock of knowledge. During operations and after closure of the facilities, the emphasis will be on monitoring and assuring the capability

to remedy unforeseen problems. In that way, the possibility is minimized that unplanned or unexpected events will compromise the integrity of the facility.

This flexible approach has more in common with research and underground exploration than with conventional engineering practice. The idea is to draw on natural analogues, integrate new data into the expert judgments of geologists and engineers, and take advantage of favorable surprises or compensate for unfavorable ones.

Natural analogues--geological settings in which naturally occurring radioactive materials have been subjected to environmental forces for millions of years--demonstrate the action of transport processes like those that will affect the release of man-made radionuclides from a repository in a similar setting. Where there is scientific agreement that the analogy applies, this approach provides a check on performance assessment methodology and may be more meaningful than sophisticated numerical predictions to the lay public.

A second element is to use professional judgment of technical experts as an input to modeling in areas where there is uncertainty as to parameters, structures, or even future events. Such judgments, which may differ from those of DOE program managers, should be incorporated early in the process; a model created in this way might redirect the DOE program substantially.

The large number of underground construction projects that have been completed successfully around the world are evidence that this approach works well. Implicit in this approach, however, is the need to revise the program schedule, the repository design, and the performance criteria as more information is obtained. Putting such an approach into effect would require major changes in the way Congress, the regulatory agencies, and DOE conduct their business.

#### The Risk of Failing to Act

Given the history of radioactive waste management in the United States, a likely alternative is that the program will continue as at present. That would leave the nation's inventory of high-level waste, indefinitely, where it is now: mostly at reactor sites at or near the earth's surface. By the year 2000 spent fuel is expected to contain more than  $3 \times 10^{10}$  curies, while High Level Waste is expected to contain another  $10^9$  curies.\* This alternative is safe in the short term--on-site storage systems are safe for at least 100 years, according to present evidence.\*\* The at-surface alternative may be irresponsible for the long run, however, due to the uncertainties associated with maintaining safe institutional control over HLW at or near the surface for centuries.

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\* Integrated Database for 1988: Spent Fuel and Radioactive Waste Inventories, Projections, and Characteristics: DOE/RW-0006 Revision 4, Sept. 1988.

\*\* Waste Confidence Decision Review. 54 FR 39767 (Sept. 28, 1989)

In judging disposal options, therefore, it is essential to bear in mind that the comparison is not so much between ideal systems and imperfect reality as it is between a geologic repository and at-surface storage. From that standpoint, both technical experts and the general public would be reassured by a conservative engineering approach toward long-term safety, combined with an institutional structure designed to permit flexibility and remediation.



## RETHINKING HIGH-LEVEL RADIOACTIVE WASTE DISPOSAL

### A Position Statement of the Board on Radioactive Waste Management

#### INTRODUCTION

##### The Origins and Purpose of This Document

Since 1955, the National Research Council (NRC) has been advising the U.S. government on technical matters related to the management of radioactive waste. Today, such review and advice is rendered by the Board on Radioactive Waste Management (BRWM or "the Board"), a permanent committee of the National Research Council. Over the past quarter century, the BRWM and its predecessors have acted as observer, critic, and adviser to the federal agencies responsible for the management of radioactive waste. In 1955, the National Research Council's Committee on Earth Sciences, the forerunner of the BRWM, first examined the problem of high-level radioactive waste (HLW) and recommended the strategy of isolation in stable geological formations. That basic approach is the one still being pursued in the United States and throughout the world. In 1983, the Board published the report of its Waste Isolation Systems Panel, a technical document that supported the use of "performance assessment." This method, first employed by the *Kärnbränslesäkerhet* (KBS) in Sweden for judging the performance of high-level waste and its packaging in geological formations, makes it possible to evaluate the ability of a repository to contain waste for the very long term. Performance assessment has become the keystone of the policies and regulations guiding the planning of HLW disposal in the United States as well as other nations.

Thus far, however, the technical programs carried out by government and industry in the United States have not led to a socially satisfactory resolution of the problem of HLW management and disposal. There are two reasons for this failure.

The first is the controversy over nuclear energy and radioactive waste disposal as part of nuclear energy development. The Board takes no position on the use of nuclear energy. However, it notes that even if nuclear power in this country were discontinued tomorrow—a highly unlikely event—we would still need to dispose of nuclear waste from existing power plants and defense programs, and we would therefore still require a viable HLW disposal program.

The second reason that radioactive waste management remains in trouble is the way in which the programs have been designed and carried out. That problem is the subject of this report: the Board believes that important scientific and technical issues concerning HLW have been widely misunderstood; the result is a set of programs that will not achieve their stated goals. Neither the technical nor the social problems of the waste materials already in existence are being handled effectively. The Board believes that the safe and effective isolation of radioactive waste is feasible. Improvements to what is now being done are described below.

These conclusions are the result of several years of discussions within the Board and are based on the decades of scientific and professional experience represented among the members of the BRWM. In July 1988 the Board convened a week-long study session in Santa Barbara, California, where the Board was joined by experts from the United States and abroad. The group divided its deliberations into four categories: (1) the limitations of analysis; (2) moral and value issues; (3) modeling and its validity; and (4) strategic planning. These categories also determine the structure of this position statement, although in the analysis here, as in the real world, there is no easy separation among them.

Although this position statement is critical of present policies, it must be emphasized that the changes that need to be made are not restricted to the U.S. government. The nature of the risks and the government's responsibility to address them need to be presented and understood in terms different from those reflected in today's public policy. Doing so will not lead to less safety but to more. Yet achieving that result will require courage on the part of leaders in government and industry, as well as a willingness to rethink risks among the public at large and in the interest groups concerned with public policies for the management of risk.

These questions touch on far more than radioactive waste, and the rethinking they imply will be difficult to launch and to sustain. The Board believes, however, that this rethinking is essential and that radioactive waste management is a reasonable place to begin. This position statement is a step in that direction.

### High-Level Waste in Context

At present, approximately 17 percent of the world's electricity is derived from about 400 nuclear power plants, although the percentage is as high as 70 percent in France and 50 percent in Sweden. The challenge of HLW disposal is dominated by the spent fuel from these nuclear power plants. Each 1,000-megawatt (MWE) nuclear power plant produces each year about 30 tons of spent fuel, which if reprocessed and vitrified could be reduced to between 4 and 11 cubic meters ( $m^3$ ) of highly radioactive glass. Some countries, including the United States, have chosen to dispose of commercial spent fuel directly. Each power plant also produces some 400  $m^3$  of short-lived, low-level waste (LLW) each year. Fuel production would leave another 86,000 tons of mill tailings on the earth's surface for each reactor, per year.

### Radioactive Waste Management Policy

Because HLW must be isolated from the living environment for 10,000 years or more, all nations faced with the task of radioactive waste disposal have chosen underground repositories as the basic technical approach. In the United States, the Department of Energy (DOE) has been given the task of designing and eventually operating such a repository. Before operations begin, however, DOE must demonstrate to the U.S. Nuclear Regulatory Commission (USNRC) that the repository will perform to standards established by the U.S. Environmental Protection Agency (EPA) that limit the release of radionuclides to specific levels for 10,000 years after disposal. Before the

USNRC will grant a license to operate a repository, DOE must present convincing data and analysis to the USNRC showing that the proposed facility can meet specified release limits.

To develop such an assessment, it is necessary to examine all credible possibilities for the movement of radionuclides from the repository and into the accessible environment. In conducting these analyses, DOE has relied heavily on building computer models of the repository and surrounding geological environment, along with possible pathways of radionuclide transport. However, preparing quantitative predictions so far into the future pushes the boundaries of our understanding of geology, groundwater chemistry and movement, and their interactions with the emplaced material (radioactive waste package, backfill, sealants, and so on). Although the basic scientific principles are well known, quantitative estimates (no matter how they are obtained) must rely on many assumptions. The resulting estimates cover a range of outcomes.

While continued scientific investigations should reduce the uncertainty, absolute certainty cannot be achieved. Indeed, a major theme of this position statement is the need for public policy to benefit from, and change in response to, accumulating experience.

## FINDINGS

### The Limitations Of Analysis

#### Overview

Engineers are unable to anticipate all of the potential problems that might arise in trying to site, build, and operate a repository. Nor can science prove that a repository will be absolutely "safe." This is so for two reasons. First, proof in the conventional sense cannot be available until we have experience with the behavior of an engineered repository system--precisely what we are trying to predict ahead of time. And second, safety is in part a social judgment, not just a technical one. While technical analyses can greatly illuminate the judgment of whether a repository is safe, technical analysis alone cannot substitute for decisions about the degree of risk that is acceptable. These decisions belong to the citizenry of a democratic society. Both of these important limitations of technical analysis have been understated, a lapse that feeds the concern and magnifies the public's distrust of nuclear waste management when these limitations are pointed out by the program's critics.

#### Uncertainty and Significant Risks

A principal source of concern over the U.S. program is the uncertainty in estimating the risks from a radioactive waste repository. Technical approaches are available to reduce or at least bound these uncertainties. Yet in focusing on ways to improve the analysis, public discussion has often overlooked a more important question: whether the uncertainty matters. This is, in principle, the domain of performance assessment, which draws together the different portions of the technical analysis so that one can see which

parts of the waste confinement system may pose environmental hazards during or after the time when the repository receives waste.

Performance assessment of a repository system is necessarily a task for computer modeling. The waste management system, which starts at the reactor and continues into the distant future of a sealed repository, includes many different parts and processes that are described through different kinds of data (with different levels of quality), and different kinds of analysis (with different levels of accuracy). It is a practical consequence of the complexity of HLW disposal, together with the fact that no one has ever operated a repository, that performance assessment is, in the end, a matter of technical judgment.

The traditional approach in such cases, where an important social decision hinges on uncertain scientific data and projections, is to inform the political decision through a consensus of the appropriate technical community. Such consensus is difficult to reach in this case, however, given the political controversy, conflicting value systems, and overlapping technical specialties involved in assessing repository performance. Indeed, the allowable residual risk associated with a permissible repository site is a political choice; EPA has taken the position that the implementation of their guidelines constitutes the exercise of this choice. Unfortunately, the number and magnitude of the uncertainties in the probabilistic approach may be expected to reintroduce political controversy. This was recognized by the High-Level Radioactive Waste Disposal Subcommittee of EPA's Science Advisory Board in their January 1984 report reviewing EPA Draft Standard 40 CFR 191. That subcommittee concluded there was

insufficient basis for agreeing with the EPA staff that the proposed release criterion with its probabilistic corollary can be demonstrated to have been met with reasonable assurance, and that this could be argued definitively in a legal setting.

The subcommittee strongly affirmed the validity of EPA's probabilistic approach, but warned that

if EPA cannot have high confidence in the adequacy and workability of a quantitative, probabilistic standard, [it should] use qualitative criteria, such as recommended by [the US]NRC.

Specifically, with regard to the first major topic of the Science Advisory Board's findings and recommendations, "Uncertainty and the Standard," the subcommittee recommended relaxing the nuclide release limits by a factor of 10, modifying the probabilistic release criteria so that

analysis of repository performance shall demonstrate that there is less than a 50% chance of exceeding the Table 2 release limits, modified as is appropriate. Events whose median frequency is less than one in one-thousand in 10,000 years need not be considered,

and, finally

that use of a quantitative probabilistic condition on the modified Table 2 release limits be made dependent on EPA's ability to provide convincing evidence that such a condition is practical to meet and will not lead to serious impediments, legal or otherwise, to the licensing of high-level-waste geologic repositories. If such evidence cannot be provided, we recommend that EPA adopt qualitative criteria, such as those suggested by the [US]NRC.<sup>1</sup>

Unfortunately none of these recommendations was adopted.

The USNRC staff, in commenting on the EPA Draft Standard, strongly questioned the workability of quantitative probabilistic requirements for the defined releases stating, in part

numerical estimates of the probabilities or frequencies of some future events may not be meaningful. The [US]NRC considers that identification and evaluation of such events and processes will require considerable judgment and therefore will not be amenable to quantification by statistical analyses without the inclusion of very broad ranges of uncertainty. These uncertainty ranges will make it difficult, if not impossible, to combine the probabilities of such events with enough precision to make a meaningful contribution to a licensing proceeding.<sup>2</sup>

The problem is compounded when the adequacy of the performance assessment--to determine if the allowable residual risk is achieved--is judged by its political impact (i.e., the effect of reopening the discussion of what is allowable residual risk) as well as its technical accuracy.

The difficulty of evaluating performance assessments is compounded by the fact that there is no actual experience in the disposal of HLW on which to base estimates of the risk. Some risk scenarios include low-probability/high-consequence events. Others are based on explicit or implicit assumptions that cannot be plausibly proved or disproved--for example, the consequences of climatic changes that could increase rainfall and groundwater flows at a repository site. The data and methodologies for modeling of repository isolation performance are still under development.

The actual performance of a repository is difficult to predict for many reasons. Geologists often disagree about the interpretation of data in analyzing the history of a site or geological structure. Long-term predictions are even more uncertain. Releases may occur thousands of years in the future, and they are likely to be diffuse and hard to detect. The potential for (and effects of) human exposure will be further shaped by unpredictable changes in demographics and technology.

These uncertainties do not necessarily mean that the risks are significant, nor that the public should reject efforts to site the repository. Rather, they simply mean that there are certain irreducible uncertainties about future risk. An essential part of any successful management plan is how to operate with large residual uncertainties, and how to maintain full public accountability as information about the risks changes with experience. This is not an impossible task: public policy is made every day under these conditions, and private firms undertake all sorts of activities in the face of uncertainty.

What is clear, however, is that a management plan that promises that every problem has been anticipated, or assumes that science will provide all the answers, is almost



certainly doomed to fail. There have been many cases where attempts to understate uncertainty have damaged an agency's credibility and subverted its mission. For this reason, experienced regulatory agencies like EPA now pay careful attention to describing the uncertainties associated with their risk assessments.

### Perceptions of Risk

Studies have linked the high public perceptions of the risk from nuclear power plants to certain qualities of that risk, in particular to perceptions that the risks are catastrophic, new, uncertain, and involuntary (i.e., beyond individual control). Radioactive waste poses risks with many of the same technical characteristics: the principal health risks (chiefly cancer and genetic defects) originate in the hazards of ionizing radiation. The risks from radioactive waste also have some of the same social characteristics as risks from nuclear reactors: a long time may pass before the hazards become apparent, dangers may be imposed involuntarily on populations, and there is a perceived possibility of catastrophe. The last perception, in particular, is qualitatively incorrect for HLW, since radioactive waste materials have far lower energy levels in comparison to those of reactors, thereby limiting the risk associated with HLW to much lower levels in virtually all accident scenarios.

Given the complexity of the potential risks from HLW, most people will transfer the judgment of the safety of geologic disposal to the experts. The key question is which experts they will listen to. The answer depends on who seems more trustworthy: citizens may have little experience with radioactive waste, but they have considerable experience in evaluating people.

The perception of integrity and competence in risk managers depends not only on their personal attributes but also on the character of the policies they implement and the institutions they represent. The current decision process is structured in a way that does not promote trust in those who are implementing the waste management program. The current situation in Nevada, for example, demonstrates the importance of local input in the acceptance of risk. The political leadership of Nevada is fighting the proposed repository and portraying their State as a victim, reinforcing the perception on the part of the broader public that the program is beyond local control.

The Department of Energy should recognize that communications about the program will be ineffective so long as Nevadans believe they have no voice in the process. To the extent that DOE can share power, however, the increased perception of local control is likely to improve acceptance of a repository. The funding of a technical review group whose members are selected by the State government would be one positive step in this direction. In order to encourage rigorous technical analysis, it should be required that the findings of this review group include a statement of the technical evidence and reasoning behind the conclusions, as is done now by the State of New Mexico's Environmental Evaluation Group for the Waste Isolation Pilot Plant.

Given the highly polarized reactions to radioactive waste disposal, it is reasonable to anticipate criticisms and challenges to the technical competence and integrity of the program and its participants. Critics of the program point to the perceived incentives to find the proposed site and technology suitable, the motivation to meet schedules and budgets, and the resulting incentive to disregard or play down troubling findings. Claims

to predict accurately events like earthquakes and climatic change are guaranteed to be challenged. These concerns have been addressed through a regulatory review process that is carefully designed to reveal errors, optimistic assumptions, and omissions; but the perceived credibility of that process can be bolstered if state and local groups and individuals have an opportunity to participate, not only in the formal review process but also through informal working relationships with project staff.

Those involved in HLW management must also avoid the trap of promising to reduce uncertainties to levels that are unattainable. Uncertainties are certain to persist. Whether the uncertainties in geologic disposal are too great to allow proceeding can only be judged in comparison to the projected risks and uncertainties for the alternatives, such as delayed implementation of disposal or surface storage of spent fuel. As a rule, the values determined from models should only be used for comparative purposes. Confidence in the disposal techniques must come from a combination of remoteness, engineering design, mathematical modeling, performance assessment, natural analogues, and the possibility of remedial action in the event of unforeseen events. There may be public desire or political pressure on implementing agencies to provide absolute guarantees, but a more realistic—and attainable—goal is to assure that the likelihood of unforeseen events is minimal, and that the consequences of such events are of limited magnitude.

Technical program managers may ask whether it is better for the public to know too much or not enough. When unforeseen events occur, for example, the public can raise questions about the validity of the technical approach, as well as the competence of the risk analysis that was used to justify it. Conversely, when foreseen events occur, they lead to questions about why they were not prevented. The technical credibility of the project team suffers in either case, but it probably suffers more when the organization has understated the risk or uncertainty.

### Moral And Value Issues

#### Overview

The foregoing discussion suggests that, in the area of radioactive waste, ethical issues are as important as management and technical decisions. Interested parties approach the issues with different views about the right way to proceed, often due to differences in moral and value perspectives. As a result, an exploration of ethical issues can illuminate the fundamental policy debates in this field by showing the technical issues in their political and social context. Such an exploration also provides scientists with an opportunity to explore their own ethical responsibilities as they provide society with technical advice on controversial subjects. During its 1988 study session the Board examined recent work on ethical questions in radioactive waste management conducted by scholars from a variety of disciplines.

These ethical concerns fall into two principal areas: (1) questions concerning the professional responsibility of scientists and engineers; and (2) questions concerning the appropriate uses of science in the decision-making process. Science and engineering are part of broader human activities, and as science enters the public arena, decisions can no longer be purely scientific; good science is not enough. Science has also become an

important source of information and analysis for the public policy process, and scientists find themselves being called to account for, and to justify the results of, those decisions. Is this responsible, good, or desirable? How can the process be improved and the parties satisfied? Scientists have been sheltered from such questions in the past, but the increasing scale, sophistication, and pervasiveness of technical information require a corresponding increase in the sophistication with which these value judgments are made.

### Three Issues of Equity

To see how questions of equity apply to radioactive waste management, consider first a study by Roger E. Kasperson and Samuel Ratick.<sup>3</sup> This project identified three sets of equity concerns, each of which raises questions of differential impact, public values, and moral accountability:

- *Labor.* Who does the work and who pays for it? Congress has determined that DOE will be responsible for the work and that the beneficiaries of nuclear power will pay for it through a surcharge on their electric rates.
- *Legacy.* What do we owe to future generations? Moral intuition tells us that our descendants deserve a world that we have tried to make better.<sup>4</sup> Posterity matters to us, independent of economic trade-offs; policy should therefore take that interest into account. The EPA regulation requiring evidence that radioactive waste releases will be limited for 10,000 years and more is an illustration of such a concern for the distant future.
- *Locus.* Who benefits, and who is exposed to risk? A repository is the final resting place for the waste from nuclear power plants that provide benefits spread over the whole nation for a short time; but it also concentrates risks and burdens along transportation routes and, for a much longer time, at the disposal site. A radioactive waste repository poses additional complications: it will be the first facility of its kind; the risks it poses are uncertain and, to the extent they exist at all, are likely to emerge over very long time spans; public fears are unusually high; and the history of federal action has raised concerns about whether the interests of local populations will be treated equitably.

These ethical questions, when applied to radioactive waste management, demonstrate that once science enters the policymaking arena, good science is no longer enough, because technical decisions are no longer simply scientific. When the questions are no longer scientific, scientists alone cannot be expected to answer them. Sheldon Reaven suggests that the Nuclear Waste Policy Act creates a "scientific trap," in which citizens are encouraged to expect certainty from flawless science, and in which scientists and engineers are encouraged to believe or pretend that they can supply it.<sup>5</sup>

Sheila Jasanoff makes the same point: the political need for accountability in the United States pressures regulators to seek a "scientifically correct" answer, even when there is none.<sup>6</sup> The attempt is doomed to scientific and political failure. It is therefore critical to recognize the boundaries of scientific understanding as it can be applied to a societal problem.

### Five Issues of Policy

These ethical considerations have been applied to the current HLW situation by an interdisciplinary team led by E. William Colglazier.<sup>7</sup> For each of five key policy issues, the study discusses the "fairness" and appropriateness of the procedures for making decisions, the distribution of costs and benefits, and the type of evidence that is considered sufficient and admissible. The study places special emphasis on the role of scientific evidence because of the large scientific uncertainties and the continuing controversy, even among experts, on what is known and not known. The study's observations include the following:

- *The need for the repository.* The core policy dispute concerns the choice between permanent disposal in a geologic repository and long-term monitored storage in an engineered facility (including at-reactor storage) at or near the surface. The controversy has been over the distribution of costs and benefits to current and future generations and to various stakeholder groups:
  - Pro-nuclear groups feel that the federal government promoted nuclear power and therefore has a special responsibility (spelled out in contractual obligations) to accept spent fuel in a timely manner for permanent disposal.
  - Many environmental groups, on the other hand, view radioactive waste as a special threat to people and the environment; they also favor permanent disposal in order to fulfill this generation's responsibility, and view interim storage as an unfair "legacy" to future generations.
  - Some proponents of interim storage, however, argue that this generation should not make decisions that would be costly to correct in the future; new technological developments may occur over the next century that could change our view of how to handle nuclear waste.

In short, all stakeholder groups agree that this generation should fulfill its responsibility to future generations, but they disagree on how to turn this value principle into policy.

- *Siting.* In making politically difficult siting decisions, political leaders have two basic options: make the choice internally and impose it on a weak constituency; or set up and follow a selection process perceived as objective, scientifically credible, and procedurally fair. When NHPA was passed in 1982 the latter course appeared necessary for both technical and political reasons. However, critics soon claimed that DOE was being political rather than objective in its decisions, citing as evidence DOE's choice of first-round sites and its decision to defer the second round of site selection. This perception led to a stalemate: DOE lacked credibility, and credibility is essential to implement the siting approach set forth in the NHPA. This stalemate was broken by Congress with the 1987 NHPA amendments, which designated Yucca Mountain, Nevada (one of DOE's first-round choices), as the initial site to be characterized and, if acceptable, to be licensed.
- *Intergovernmental sharing of power.* Procedural values were also important in NHPA, which established rules for sharing power among the affected governmental entities. However, the states feel that federal agencies, and

especially DOE, have generally chosen to try to meet milestones rather than slow down the process to live up to the spirit of "consultation and cooperation." DOE, for its part, feels that it has a mandate to move forward expeditiously; it has tried to accommodate the states, which (in DOE's view) seek delays to throw obstacles in the way of efficient implementation. Nevada, in particular, interprets the 1987 NWSA amendments as unfair on procedural (as well as distributional and evidential) grounds.

- **Safety.** The fundamental safety issue is the determination of a fair evidential process and standard of proof for showing that the repository is acceptably safe for the thousands of years over which the waste will remain dangerously radioactive. The United States has adopted a set of licensing criteria (e.g., groundwater flow time, package lifetime, waste release limits, and so on) that require considerable certainty. As is often the case with frontier science, however, knowing more may actually increase rather than decrease the uncertainties, at least in the near term. The evidential uncertainties in assessing repository safety may point to a more flexible and evolutionary approach (see below); but this conflicts with the concerns to keep to a fixed schedule, so as to limit costs, discharge obligations to future generations, and meet contractual commitments to utilities holding spent fuel.
- **Impacts.** The debate over the distributional impacts of the repository program include such issues as who should pay for the program, how the impacts can be fairly calculated, and what is fair compensation for negative impacts. NWSA determined that the costs should be paid by the beneficiaries of nuclear-generated electricity through fees, initially, of one mill per kilowatt-hour. An evidential dispute concerns the potential "stigma effect," including lost jobs and lost tax revenues, due to nuclear waste; the social science methodologies for assessing this effect are still controversial. Another issue concerns the use of incentives and compensation: in the 1987 amendments, Congress authorized special payments for the host state, provided it forgoes its right to object. This runs the risk of being perceived by opponents as a bribe, offered in exchange for taking otherwise unacceptable risks. Congress also sought a procedural solution to these distributional impacts through creation of the Office of Special Negotiator, hoping that the negotiator might find an acceptable arrangement with the host state.

Consideration of these policy debates regarding the disposal of radioactive waste leads to three important conclusions:

- no interested party has an exclusive claim to be rational or to articulate the public interest;
- what is considered fair or unfair is subjective and can change over time;
- and with regard to repository safety, the issue is acceptability rather than certainty—acceptability being what is acceptable to society, given the evidential uncertainties, perceptions of risk, and contentious stakeholder debates.

These conclusions highlight the advantage of an empirical approach—one that examines fairness in process, outcomes, and evidence; one that reflects an understanding of the values as well as the interests of the stakeholders. Such an approach may lead to



policies that have a greater chance of surviving over time because they are more widely perceived as fair.

### Modeling And Its Validity

#### Overview

Models based on geological principles play a central role in the design and licensing of a waste repository. Because this is where science enters into the design and evaluation process, the Board discusses the appropriate use of models at some length, including the following topics: the purposes for which models are used; the relationship among modeling, treatment of uncertainties, and regulation; and supplements to the use of models in the current program.

The role of models in the design and licensing of the repository should properly be understood to be different from the use of models in designing airplanes or licensing nuclear reactors. There are major sources of uncertainty in quantitative geophysical modeling—even geohydrology, the best developed, can provide only approximate answers. Geoscientists will need more time to learn how to do more reliable predictive modeling of near-term events, and some events may prove to be chaotic—that is, impossible to predict in detail.

In particular, there is a critical need for (1) better communication between modelers and geological experts, in order to improve model prediction; and (2) a more open, quality-reinforcing process such as could be obtained through a peer-reviewed research program at universities and elsewhere. This would do much to improve technical and public confidence in models. DOE could support such an effort by allocating R&D funds, possibly through or in cooperation with the National Science Foundation, for model improvements.

In the meantime, however, models can be useful in identifying and evaluating significant contributors to risk and uncertainty. Models are not well suited to describe the risk and uncertainties to lay audiences, however. Natural analogues, if they can be found, are far more useful for this purpose (see below).

Problems of repository performance assessment, according to the scheme shown in Figure 1, belong in Region 2 or at the border between Regions 4 and 2. However, there is a general tendency to assume that we can address them using a Region 3 approach: that is, start with a deterministic model that incorporates all "relevant" contributors to overall behavior, and then attempt to collect enough data to move the problem from Region 2 into Region 3. In reality, however, this approach leads to increasingly complex models and increasingly expensive site evaluations, without a concomitant improvement in either understanding or design. Anthony M. Starfield and P. A. Cundall have suggested that we sometimes demand answers that the model is incapable of providing because of complexity or input demands. The design of the model should be driven by the questions that the model is supposed to answer, rather than by the details of the system that is being modeled. Under the present HLW program, geophysical models are being asked to provide answers to questions that they were not designed to tackle.<sup>9</sup>

### Models and Modeling Problems

Figure 1 illustrates a general classification of the types of modeling problems taken from C. S. Holling.<sup>6</sup> In Region 1 there are good data but little understanding; this is where statistics is the appropriate analytic tool. In Region 3 there are both data and understanding; this is where models can be built, validated, and used with conviction. The use of finite-element models in structural design is a good example of Region 3 models. Regions 2 and 4 contain problems that are data-limited in the sense that the relevant data are unavailable or cannot be placed in a rigorous theoretical framework. In Region 2 the understanding of basic mechanisms is good; it is the detailed information that is unobtainable. In Region 4 there is not even a sound understanding of the basic mechanisms and interactions.

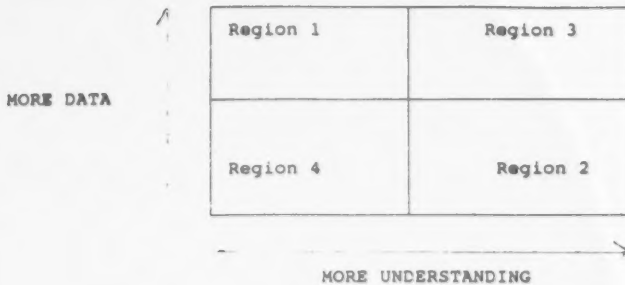


Figure 1. Types of modeling problems.

### Appropriate Uses for Geophysical Models

In the Board's judgment, a scientifically sound objective of geophysical modeling is learning, over time, how to achieve the long-term isolation of radioactive waste. That is a profoundly different objective from predicting the detailed structure and behavior of a site before, or even after, it is probed in detail. Yet, in the face of public concerns about safety, it is the latter use to which models have been put. The Board believes that this is scientifically unsound. This conclusion is based on review of the modeling approach used by DOE and the regulatory agencies in order to implement the NWPA.

In order to support the regulatory and political argument that a site will be safe, it is necessary to make detailed, expensive, and extended extrapolations. These are informed speculations based on existing knowledge. In many instances the guesses are likely to be correct. The geotechnical models used to assure that the foundations of a building or bridge will be secure in the event of earthquakes provide an example of a well-founded

predictive use of geophysical modeling. But to predict accurately the response of a complex mass of rock and groundwater as it reacts over thousands of years to the insertion of highly radioactive materials is not possible.

This point is important to the public concerns that have surrounded the U.S. radioactive waste program. Use of complex computer models is necessary to apply well-known geophysical principles in order to estimate or to set bounds on the behavior of a site, so that its likely suitability for a waste repository can be evaluated. But it is impossible to stretch the almost always incomplete understanding of a site into an accurate quantitative projection of whether a repository will be safe if constructed and operated there. Even after a detailed and costly examination of the site itself, only an informed judgment can be reached, and even then there will be uncertainties.

As modelers have become more aware of the processes they are attempting to model, they are also recognizing that the geological environment is more complex than originally thought and that quantitative prediction is correspondingly more difficult and uncertain. Many computer simulation models of geological environments are based on deterministic models that have been used successfully in branches of mechanics such as aerospace engineering, where the basic phenomena are much better defined. Such models are of limited value for the ill-defined, data-limited, long-term situations such as the repository isolation problem. It is illusory to expect accurate quantitative estimates of radionuclide releases from them.

#### Sources of Uncertainty in Geophysical Models

Performance assessments--estimates of the repository's ability to isolate HLW--are based on current computer simulations and parameters derived from laboratory and field measurements. As a consequence, they will have large uncertainties associated with the predicted performance. These uncertainties could pose serious obstacles in demonstrating compliance with licensing requirements. Discussions at BRWM's 1988 study session identified four principal causes of uncertainty:

1. *Structural uncertainty.* Do the equations adequately represent the operative physical processes? Do we in fact understand the system well enough to model it mathematically? Modeling will be most successful in solving Region 3 problems (see Figure 1), where we have a great deal of data and a good understanding of how the system works.
2. *Parametric uncertainty.* Have we chosen the right values for the variables (e.g., permeability) in the equations? Have we in fact chosen the right variables to represent the behavior of the system? Are our measurement techniques valid? Will they produce enough, and good enough, data?
3. *Uncertainties in initial and boundary conditions.* Have we interpolated adequately from a few spatially isolated point measurements to a broad three-dimensional domain (e.g., groundwater, heat, in situ stress)?
4. *Uncertainties in forcing functions.* How well can we characterize past and future events that might play a part in the fate of the repository (e.g., climate, tectonics, human intrusion)?

Urgent attention should be given to examining these and other causes of uncertainty, but even with continuing research along the present lines, improvement will come slowly. It may even turn out to be appropriate to delay permanent closure of a waste repository until adequate assurances concerning its long-term behavior can be obtained through geophysical studies. Judgments of whether enough is known to proceed with placement of waste in a repository are needed throughout the life of the project. But to repeat the Board's earlier point: these judgments should be based on a comparison of the available alternatives, rather than just a simplistic debate over whether, given current uncertainties, a repository site is "safe." Even when the detailed behavior of an underground repository is still under study, it may well be safer to put waste there, in a way that permits retrieval if necessary, rather than leaving it at reactors or in storage at, or near, the surface of the earth.

#### Modeling Limitations—An Example

The inherent difficulties of modeling are illustrated by the case of groundwater flow, which is used as an example precisely because it is the best developed in terms of modeling. Groundwater flow has been extensively modeled for a broad range of engineering problems, and it consequently has a richer base from which to draw than do many other aspects of repository isolation. Groundwater flow is also generally accepted as the primary mechanism by which radionuclides could move from the repository to the biosphere, so it has been emphasized in modeling studies of repository isolation. Several experts, however, have commented on the difficulty of applying classical hydrology models to the problem of radioactive waste isolation.

Groundwater hydrologists are becoming increasingly aware that inadequate and insufficient data limit the reliability of traditional deterministic [distributed-parameter] groundwater models. The data may be inadequate because aquifer heterogeneities occur on a scale smaller than can be defined on the basis of available data, time-dependent variables are monitored too infrequently, and measurement errors exist.<sup>10</sup>

To carry out these [repository flow] calculations, hydrogeologists are applying geostatistical models and stochastic simulation methods originally developed to assess piezometric response in near-surface unconsolidated aquifers over limited spatial distances and short time frames with relatively abundant data. . . . These techniques may not be as valuable when applied to the assessment of radionuclide transport in deep rock formations, over large distances and long time frames, under conditions of sparse data availability. . . . [The authors] have repeatedly drawn attention to the potential problems associated with the geostatistical methods (Bayesian and otherwise) when data networks are sparse and sample sizes small. In our opinion, this is the potential Achilles heel for the application of geostatistics at nuclear repository sites.<sup>11</sup>

With regard to repository isolation modeling, increased study has thus far resulted in the identification of greater complexity. Progress is being made toward including some

of this complexity in the models, at least in terms of groundwater studies; but other geotechnical aspects of repository isolation (such as constitutive properties of rock joints, excavation and repository scale deformation behavior, and regional in situ stress) are far less developed. It will take years of additional research to represent them adequately in the models. As a result, the prospects are poor, especially in the short term, for models that can produce reliable quantitative measures of isolation performance.

### Appropriate Objectives for Modeling

Repository performance assessments are unlikely to prove beyond doubt that risks are below established limits. Nor do the regulations require it—EPA requires only a "reasonable assurance." The problem is that in a case without clear precedents, it is unclear what is "reasonable." The Board's point is that unsound use of technical information is not a proper substitute for the political reasoning that, in a democratic society, must in the end win consent for taking reasonable steps to advance public health and safety.

In light of the limitations of technical knowledge, the Board concludes that it makes sense to conduct the assessments through an iterative process, in which the assessment provides direction to those characterizing a repository site and developing the repository engineering features. As further information is developed about the candidate site, it is also used in the performance assessment.

Many of the uncertainties associated with a candidate repository site will be technically interesting but irrelevant to overall repository performance. Conversely, the issues that are analytically tractable are not necessarily the most important. A key task for performance modeling is to separate the significant uncertainties and risks from the trivial. Similarly, when there are technical disputes over characteristics and processes that affect calculations of waste transport, sensitivity analysis with alternative models and parameters can indicate where further analysis is required and where enough is known to move on to other concerns.

### Using Models To Reduce Uncertainty

Models do have an indispensable role in developing understanding of such problems, provided that the models are developed and used within the proper limitations. In other words, modeling can be used to improve models. The following quotations from those concerned with such problems illustrate this point:

... much time can be saved in the early stages of hypothesis formulation by the exploration of these hypotheses through mathematical models. Similarly, mathematical models can be used to investigate phenomena from the viewpoint of existing theories, by the integration of disparate theories into a single working hypothesis, for example. Such models may quickly reveal inadequacies in the current theory and indicate gaps where new theory is required.<sup>12</sup>



The updating properties of the Bayesian approach . . . are well suited to the iterative approach we espouse for the modeling/data gathering sequence at a site. We feel that the first modeling efforts should precede or accompany initial site investigations.<sup>13</sup>

A good example of this general approach is the "regionalized sensitivity analysis" approach, by which G. M. Hornberger and his collaborators have been able to identify the "critical uncertainties" in applying a particular model to several data-sparse ecological problems, and thereby define programs of investigations to reduce those uncertainties.<sup>14</sup>

In summary, models should be qualitatively sensible, robust to sensitivity analysis, and independent of minor effects or processes, and they should include acceptable levels of uncertainty. However, models cannot prove that the repository is safe, nor can they resolve public concerns about the repository.

#### Supplements to Modeling

**Natural Analogues.** Because models cannot be conclusive with regard to the safety of a repository site, it is important to think carefully about natural analogues. These are natural "test cases," geological settings in which naturally occurring radioactive materials have been subjected to environmental forces for millions of years. These natural experiments demonstrate the action of transport processes that are similar to those that will govern the release of man-made radionuclides from a repository in a similar setting.

The natural analogue approach depends, of course, on whether the natural case is in fact an analogue for a repository situation. Where there is scientific agreement that the analogy applies, however, the approach is powerful because it allows us to predict processes with confidence over many millennia. And natural analogues can serve two additional roles: (1) they can provide a check on performance assessment methodology; and (2) they may be more meaningful than sophisticated numerical predictions to the lay public. The alternative management strategy described in the following section would make substantial use of natural analogues, such as undisturbed natural deposits of radioactive elements and groundwater systems, in order to illuminate the behavior of the geologic environment.

**Professional Judgment.** A second approach is to use the professional judgment of technical experts as an input to modeling in areas where there is uncertainty as to parameters, structures, or even future events. Such judgments, which may differ from those of DOE program managers and their staffs, should be incorporated early in the process. A model created by this process can redirect the DOE program substantially.

It is important to bear in mind that all uses of technical information entail judgments of what is important and what is less so. If the technical community is to learn from the successes and failures of the DOE program, it is essential that these technical judgments be documented. Setting out the reasoning of DOE staff and of independent outside experts contributes to learning and builds credibility in the process even when the experts disagree with DOE staff and among themselves.

of time required for waste isolation. This attribute of Yucca Mountain, alone, is sufficient reason for you to find, now, that the Yucca Mountain Site is disqualified pursuant to the intent of Section 112(a) of the Nuclear Waste Policy Act, and the DOE siting guidelines (10 CFR Part 960) which were promulgated to implement that section of the Act.

The existing information regarding the number and ages of geologic faults intersecting and associated with the Yucca Mountain Site, coupled with the extremely complex tectonic and hydrologic setting of the site, should certainly serve as a warning that there is significant risk of disruption of repository performance during the waste isolation period. It is also highly questionable whether geophysical technology exists, or can become available by the time needed, to test the site parameters necessary for characterization of the tectonic setting and site performance assessment. If the standards of conservative technical judgment and the use of reasonably available technology called for in the DOE siting guidelines are applied, as they must be, once again, there exists now, sufficient reason for disqualification of the site pursuant to the guidelines.

In the area of hydrology, as related to groundwater travel time evaluations, the DOE appears to have abandoned any pretext of conservative scientific assumptions, and has embraced with enthusiasm an unwarranted optimism.

While a thick unsaturated zone surrounding a geologic repository may appear beneficial to waste isolation in a generic sense, characterizing that zone at Yucca Mountain sufficiently to assure an understanding of present groundwater movement is beyond available hydrologic modelling and testing capabilities. Furthermore, the ability to validate such models, as is required for use in long-term performance assessment relative to the site hydrology, does not exist at present, and likely cannot be achieved within the time period available for site characterization. The scientific community acknowledges that the science of unsaturated zone hydrology necessary for characterization and modelling of future performance is in its infancy. It further recognizes that it will take considerable basic research and time, first in settings less complex than Yucca Mountain, to bring this discipline to a level of maturity and validation sufficient for acceptable application to the Yucca Mountain project.

Aside from the problem of hydrologic modelling of the unsaturated zone, Nevada's previous reviews and comments have pointed out that conservative calculations using DOE's Yucca Mountain data can show that the NRC's groundwater travel time standard for licensing would be violated, even if DOE's optimistically postulated slow matrix flow condition prevails. Evaluation of existing data shows that the faster, fracture flow condition exists, and suggests that it likely prevails. Therefore,

## Implications for Program Management

The Board has concluded that geological models, and indeed scientific knowledge generally, are being inappropriately applied in the U.S. radioactive waste repository program. That misapplication prompts this Board to outline an alternative management strategy. The next section describes an alternative management approach that employs natural analogues and professional judgment in a program design that uses science appropriately in the search for a safe disposal system. Putting such an approach into effect, however, would require major changes in the way Congress, the regulatory agencies, and DOE conduct their business. Such changes will be difficult to achieve, but the Board has reluctantly concluded that nothing else will put to rest the problems that plague the national program today.

## Strategic Planning

### Overview

There is no scientific reason to think that an acceptable HLW repository cannot be built and licensed. For historic and institutional reasons, however, DOE managers often feel compelled to "get it right the first time." This management strategy runs the risk of encountering "show-stopping" problems that may delay licensing and will certainly cause further deterioration of public and scientific trust.

The alternative would be a more flexible, experimental strategy that embodies the following principles:

- respond with conservative design changes as site attributes are discovered;
- use modeling to identify areas where more information is needed; and
- allow for remediation if things do not turn out as planned.

Implicit in this approach is the need to revise both technical design and regulatory criteria as more information is discovered. This is difficult to achieve in a governmental structure that disperses authority among legislative and executive agencies and separates regulation from implementation. When presented with intense controversy, such an institutional arrangement breeds distrust among governmental units and the public. In that setting, partial remedies further entangle the procedural morass.

More practically, however, DOE can enhance the credibility of the program and reduce the likelihood of late-stage surprises by (1) encouraging effective communication within its complex management structure; and (2) providing incentives for field personnel to identify and solve problems. DOE and the USNRC can also enhance credibility by encouraging periodic external reviews of the repository design, construction, and licensing requirements and associated processes.

### Policy Context

The present U.S. approach to HLW disposal is increasingly vulnerable to being derailed by minor surprises. This vulnerability does not arise from a lack of talent or effort among the federal agencies and private contractors working on the program. Nor does the design or construction of the repository represent an unusually difficult technical undertaking. Instead, the program is at risk because it is following the wrong approach to implementation. The current predetermined process, in which every step is mandated in detail as in the more than 6,000 page "Site Characterization Plan,"<sup>15</sup> is inappropriate.

The current policy calls for a sequential process in which EPA and the USNRC first establish the criteria for safe disposal, and then DOE describes in detail what steps will be taken to move through site characterization, licensing, and operation of the facility. The result of this approach is that any late change, by any of the participating agencies, is taken as an admission of error.

And late changes are bound to happen. One worker was killed and five injured in an HLW repository under construction in West Germany when a support ring failed unexpectedly. At the Waste Isolation Pilot Plant (WIPP) in New Mexico, the discovery of pockets of pressurized brine in formations below the repository level led to public outcries and a continual National Research Council review of the suitability of the site.

The United States seems to be the only country that has taken the approach of writing detailed regulations before all of the data are in. Almost all other countries have established limitations on the allowable levels of radiation dose to individuals or populations resulting from repository establishment--but have taken a "wait and see" approach on design, while collecting data that may be of use in setting design. The United States, on the other hand, seems to have felt that detailed regulations can be, in fact must be, written without regard to any particular geological setting or other circumstance. As a direct consequence, the U.S. HLW program is bound by requirements that may be impossible to meet, even though overall dose limits can be achieved.

### Alternative Management Strategies

The preceding sections have shown that there are a number of unresolved issues in the U.S. radioactive waste disposal program, as well as (and in part because of) high levels of uncertainty and public unease about the performance of the repository. The Board's consideration of these subjects indicates that the proper response to distrust is greater openness in the process, and that the proper response to uncertainty is greater knowledge and flexibility, as well as redundancy of barriers to nuclide transport. The U.S. program will continue to face controversy until it adopts a management strategy based on these principles.

The current approach to the design, construction, and licensing of the Nevada site is derived from the philosophy and procedures used for licensing nuclear power plants. The characteristics of the repository and its geological setting are carefully determined and specified as a basis for a complex set of calculations that describes the behavior of the system. This model is used to generate predictions of the migration of radioactive

elements into the biosphere and analyzes the consequences of various events ("scenarios") that might affect the site over the next 10,000 years, in order to demonstrate that the repository site meets regulatory requirements (i.e., is "safe"). Based on the model and geologic studies of the site, the construction of the repository is specified in detail and then carried out under an aggressive quality assurance program, which is designed to withstand regulatory review and legal challenge. Within these requirements it is the geological setting that ensures isolation, not the engineered characteristics of the system; closure aims for complete entombment and discourages subsequent remediation. For all the reasons discussed above, a management process based on the regulation of nuclear power stations (a Region 3 type problem: see Figure 1) is inappropriate to the development of a waste repository.

A well-documented alternative to this approach is being followed, to various degrees, by countries such as Canada and Sweden. The exploration and construction of a geological test facility and a low-level waste repository, respectively, follow a flexible path, allowing each step in the characterization and design to draw on the information and understanding developed during the prior steps, and from prior experience with similar underground construction projects. During and subsequent to the closing of the repository, the emphasis will be on monitoring and on the ability to repair, in order to minimize the possibility that unplanned or unexpected events will compromise the integrity of the disposal system. Engineered modifications can be incorporated (e.g., in the waste containers or in the material used to backfill the repository) if the computer models suggest unacceptable or irreducible uncertainties in the performance of the unmodified containment system.

The Canadian experience at their Underground Research Laboratory provides a good example. All of the major rock structures and groundwater conditions were defined from surface and borehole observations before shaft construction began. Detailed geological structure can never be totally determined from surface information, however, and the final details of the facility design were modified to take account of information gathered during shaft construction.

What are the risks and benefits of the two approaches? The U.S. approach facilitates rigorous oversight and technical auditing. Its goals and standards are clear, and, if carried out according to specifications, this approach is robust in the face of administrative or legal challenge. It is designed to create a sense of confidence in the planning and operation of the repository, and it facilitates precise answers to specific technical questions.

However, such an approach is not consistent with normal geologic or mining practice. It assumes that the properties of the geologic medium can be determined and specified in advance to a degree analogous to that required for man-made components, such as reinforcing rods, structural concrete, or pipes. In reality, geologic exploration and mine construction never proceed in this way. Most underground construction projects are more qualitative, using a "design (and improve the design) as you go" principle. New sections of drill core often reveal surprises that must be incorporated into the geologists' concept of the site, integrated with past experience, and used to modify the exploration plan or mine design. In a project where adherence to predetermined specifications is paramount, the inherent variability of the geologic environment will result in endless changes in the specifications, with resultant delays, frustration for field personnel, high



overhead costs, and loss of public confidence in both the suitability of the site and the competence of the professionals working on the project.

The second approach has more in common with research than with conventional engineering practice. This approach continually integrates new data into the expert judgments of geologists and engineers. It makes heavy use of natural analogues, such as undisturbed natural deposits of radioactive elements and groundwater systems, in order to illuminate the behavior of the geologic environment. It can immediately take advantage of favorable surprises and compensate for unfavorable ones. That this approach works well is evidenced by the enormous number of underground construction projects in diverse geologic settings that have been completed successfully around the world. These projects were not designed to contain radioactive waste for thousands of years, but many of them faced technical problems of comparable magnitude, such as crossing active faults, sealing out massive groundwater flows, or stabilizing highly fractured and structurally weak rock masses.

The second approach, with its reliance on continuous adaptation, would be much more difficult to document, audit, and defend before a licensing authority or court of law than is the more prescriptive approach. Some aspects of quality assurance can work well, such as document and sample control, the use of standard procedures and tools, and personnel qualifications. Other quality assurance techniques are likely to be contentious and may be impossible to implement in the same way they are implemented in nuclear power plants, including design control, instructions, procedures, drawings, inspections, and control of nonconforming items. An alternative is to use an aggressive and independent peer review system to appraise the decisions made and the competence of the technical personnel and managers responsible.

The legal system is able to accept expert opinion as a basis for action or assessments of action, but one cannot predict whether a repository could ever be licensed in the face of the batteries of opposing "experts" who would inevitably be called on to assess a flexibly designed and constructed repository for HLW disposal. The debate will hinge in part on a clear understanding of the alternatives against which a proposed "solution" will be judged. By contrast, the EPA standards and USNRC regulations define requirements that, if met, form the basis for the presumption that the facility is "safe."

Given the unhappy history of radioactive waste disposal in the United States, however, one very real and likely alternative is that nothing at all will be done. In judging disposal options, therefore, one should also adopt inaction or some other likely scenario as a default option, so that comparisons can be made and progress consistently assessed over time. The combination of a conservative engineering approach and designed-in maximum flexibility, to allow unanticipated problems to be corrected, should reassure both technical experts and concerned nonexperts. The barrier is not logical but institutional, and the prescriptive approach in the U.S. program is dictated by a governmental structure that separates regulation from implementation.

Within the present program, for example, "quality assurance" has become the *bête noire* of frustrated field personnel, who are trying to work within a system that is hostile to surprises in a world that is full of them. Because almost any geologic phenomenon has more than one possible cause, flexibility (including the recognition that uncertainty is inevitable and must be accommodated) is more likely to lead to the design and construction of a safe repository system than are rigid, predetermined protocols. In employing and evaluating such an adaptive approach to construction, emphasis focuses



on those decisions that have irreversible or noncorrectable consequences on disposal, rather than on the myriad small adjustments that do not affect the basic flexibility and robustness of a repository.

### The Elements of a More Flexible System

In a program governed by this alternative approach, change would not be seen as an admission of error; the system would be receptive and responsive to a continuing stream of information from site characterization. The main actors would reduce their reliance on detailed preplanning during initial site characterization, making it possible to debug the preliminary design during rather than before characterization.<sup>16</sup> But the necessary conditions of the system are flexibility and resiliency—flexibility to respond rapidly to ongoing findings in the geology, geohydrology, and geochemistry (within broad constraints); and resiliency to continuously adjust the performance assessment to reflect new information, especially where such information indicates possible precursors of substantial increases in risk. These qualities could be developed through the following steps:

- *Iterative performance assessment.* The basic approach outlined here would start with a simplified performance assessment, based on known data and methods of interpretation. Given the inherent uncertainties and technical difficulties of the process, the present system may well expend large efforts on small risks, and vice versa. An iterative approach, on the other hand, could allow characterization efforts to give priority to major uncertainties and risks, while there is still time and money left to do something about them. As in probabilistic risk assessment, analysis focuses on efforts to reduce the important risks and uncertainties. In this case, that means acquiring information on the design features and licensing criteria that are most likely to determine whether the site is suitable or should be abandoned.
- *Fixing problems vs. anticipating problems.* The underlying concept of the present, anticipatory U.S. management strategy is "Get it right the first time." One result is a 6,300-page site characterization plan for Yucca Mountain. For the reasons described above, however, a process based on getting all of the needed measurements and analysis on the first pass, with acceptably high quality, is not likely to succeed. The geological environment will always produce surprises, like the pockets of pressurized brine at WIPP. No matter what technical approach is initially adopted, the design can be improved by matching it with specific features of the site. Experiments are now being conducted at WIPP with backfill material and other engineered barriers that were not part of the original design. These are being tried as ways to make the disposal system as a whole robust in the face of newly discovered uncertainties in the geology.
- *Define the problem broadly.* As characterization proceeds, especially if it is done without the guidance of iterative performance assessment, DOE may eventually find it difficult or impossible to meet some of the criteria set by the USNRC and/or EPA. This will not mean that Yucca Mountain is unsuitable for a repository—the problem could be with the detailed criteria. This is no reason to

arbitrarily abandon the release limits--it is the more detailed requirements that may need to be reconsidered, since they ultimately affect the release limits and the imputed dose. However, one should not take EPA's release standards or the USNRC's detailed licensing requirements as immutable constraints. They are roadmarkers to, and surrogates for, dose limits. Although the EPA standards and the USNRC regulations recognize and accept a certain level of uncertainty, the discussion to date of the application of these standards and regulations does not warrant confidence in the acceptance of uncertainty in licensing procedures.

Some process is needed in order to determine whether DOE's inability to meet a particular requirement is due to a disqualifying deficiency in the site or to an unreasonable regulatory demand, one that is unlikely to be met at any site and is unnecessary to protect public health. And to the extent that regulatory criteria can be corrected earlier instead of later in the process, they are more likely to be perceived as technical adjustments rather than as a diminution of public safety. Given the history of U.S. efforts to dispose of radioactive waste, current plans for the program have little chance of progressing without major modification in the 20 years or more that will be required to get a repository into operation.

## RECOMMENDATIONS

The Board's conclusions are explicit or implicit throughout this document, as are many of the actions it would recommend to the various players. These recommendations are summarized below.

1. Congress should reconsider the rigid, inflexible schedule embodied in NWPA and the 1987 amendments. It may be appropriate to delay the licensing application, or even the scheduled opening of the repository, until more of the uncertainties can be resolved. The Secretary of Energy's recent announcement of a more realistic schedule, with the repository opening in 2010 rather than 2003, is a welcome step.
2. The Environmental Protection Agency, during its revision of the remanded 40 CFR Part 191, should reconsider the detailed performance standards to be met by the repository, to determine how they affect the level of health risks that will be considered acceptable. In addition, EPA should reexamine the use of quantitative probabilistic release criteria in the standard and examine what will constitute a reasonable level of assurance (i.e., by what combination of methods and strategies can DOE demonstrate that those standards will be met?).  
All other countries use only a dose requirement. In setting regulatory standards and licensing requirements, the EPA should consider using only dose requirements.
3. The U.S. Nuclear Regulatory Commission, likewise, should reconsider the detailed licensing requirements for the repository. For example:
  - What level of statistical or modeling evidence is really necessary, obtainable, or even feasible?
  - To what extent is it necessary to prescribe engineering design, rather than allowing alternatives that accomplish the same goal?
  - What can be done to accommodate design changes necessitated by surprises during construction?
  - What new strategies (e.g., engineered features like copper containers) might be allowed or encouraged as events dictate?
4. The Department of Energy, for its part, should continue and also expand its current efforts to become a more responsive player in these regulatory issues. The following activities should be included:
  - publicly negotiated prelicensing agreements with the USNRC on how to deal with the high levels of uncertainty arising from numerical predictions of repository performance;
  - publicly negotiated prelicensing agreements with the USNRC on improved strategies for performance assessment;
  - active negotiations with EPA and the USNRC on the real goals and precise definitions of their standards and requirements;
  - an extramural grant program, in cooperation with the National Science Foundation, for the development of improved modeling methodology, in combination with training programs and public education efforts;

- expanded use of expert scientists from outside the program to review and critique detailed aspects and to provide additional professional judgment;
  - greatly expanded risk communication efforts, aimed at reaching appropriate and achievable goals acceptable to the U.S. public;
  - meaningful dialogue with state and local governments, Indian tribes, environmental public interest groups, and other interested organizations.
5. The Department of Energy should make greater use of conservative engineering design instead of using unproven engineering design based on scientific principles.
  6. The Department of Energy should participate more actively in international studies and forums, such as those sponsored by the International Atomic Energy Agency, the Nuclear Energy Agency, and the Commission of European Communities, and should subject its plans and procedures to international scientific review, as Sweden, Switzerland, and the United Kingdom have already done.
  7. Although geologic disposal has been the national policy for many years, and the Board believes it to be feasible, contingency planning for other sites and options (for example Subseabed Disposal of spent fuel and high-level radioactive waste) should be pursued. The nation, the Congress, the federal government, utilities, and the nuclear industry should recognize the importance of contingency planning in the event that some issue should make it impossible to license a geologic repository.

## NOTES

1. Report on the Review of Proposed Environmental Standards for the Management and Disposal of Spent Nuclear Fuel, High Level and Transuranic Radioactive Wastes (40 CFR 191) by the High-Level Radioactive Waste Disposal Subcommittee of the Science Advisory Board, U.S. Environmental Protection Agency, (January 1984) pp. 10-14.
2. May 10, 1983 letter from John G. Davis to EPA transmitting USNRC staff comments on the proposed High-Level Waste Standard (40CFR 191).
3. Roger E. Kasperson and Samuel Ratick, "Assessing the State/Nation Distributional Equity Issues Associated with the Proposed Yucca Mountain Repository: A Conceptual Approach," a technical report prepared for the Nevada Nuclear Waste Project Office and Mountain West Research, Inc., (June 1988) pp. 1-22.
4. Each generation must not only preserve the gains of culture and civilization, and maintain intact those just institutions that have been established, but it must also put aside in each period of time a suitable amount of real capital accumulation." J. Rawls, "A Theory of Justice," (Harvard University Press, 1971) p. 284.
5. Sheldon J. Reaven, "How Sure is Sure Enough," Department of Technology and Society, State University of New York at Stony Brook, draft paper prepared for the project referenced in Colglazier (note 7), (1988).
6. Sheila Jasanoff, draft chapter "Acceptable Evidence in a Pluralistic Society," in Acceptable Evidence: Science and Values in Hazard Management, Deborah G. Mayo and Rachelle Hollander, eds. (Oxford University Press, 1990, in press).
7. This project, supported by the National Science Foundation, included the following researchers: E. William Colglazier, David Dungan, and Mary English of the University of Tennessee; Sheldon Reaven of the State University of New York at Stony Brook; and John Stucker of Carter Goble Associates. Some of the project papers published to date by Colglazier include: "Evidential, Ethical, and Policy Disputes: Admissible Evidence in Radioactive Waste Management," in Acceptable Evidence: Science and Values in Hazard Management, Deborah G. Mayo and Rachelle Hollander, eds. (Oxford University Press, 1990, in press); "The Relation of Equity Issues to Risk Perceptions and Socioeconomic Impacts of a High Level Waste Repository," Waste Management '89, proceedings of the Waste Management '89 Conference (University of Arizona, 1989); "The Policy Conflicts in the Siting of Nuclear Waste Repositories," Annual Review of Energy, Vol. 13 (1988), pp. 317-357; and "Value Issues and Stakeholders' Views in Radioactive Waste Management," Waste Management '87, proceedings of the Waste Management '87 Conference (University of Arizona, 1987).



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11. R. A. Freeze, G. de Marsily, et al., "Some Uncertainties About Uncertainty," paper presented at the DOE/AECL symposium on the use of geostatistics in nuclear waste disposal, San Francisco (September 1987).
12. George M. Hornberger and R. C. Spear, "An Approach to the Preliminary Analysis of Environmental Systems," Journal of Environmental Management, Vol. 12 (1981), pp. 7-18; J. N. R. Jeffers, "The Challenge of Modern Mathematics to the Ecologist," in Mathematical Models in Ecology, J. N. R. Jeffers, ed. (Blackwell Scientific, Oxford, 1972).
13. Freeze, de Marsily, et al., op. cit.
14. G. M. Hornberger, B. J. Cosby, and J. N. Galloway, "Modeling the Effects of Acid Deposition: Uncertainty and Spatial Variability in Estimations of Long-Term Sulfate Dynamics of a Region," Water Resources Research, Vol. 22, No. 8 (August 1986) pp. 1293-1302.
15. Department of Energy, Office of Civilian Radioactive Waste Management, Site Characterization Plan: Yucca Mountain Site, Nevada Research and Development Area, Nevada, DOE/RW-0199 (U.S. Department of Energy, Oak Ridge, TN, December 1988).
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STATE OF NEVADA

TESTIMONY BEFORE THE UNITED STATES SENATE

SUBCOMMITTEE ON NUCLEAR REGULATION

COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

BY ROBERT R. LOUX, EXECUTIVE DIRECTOR

AGENCY FOR NUCLEAR PROJECTS, NUCLEAR WASTE PROJECT OFFICE

RESPONSES TO PRE-HEARING QUESTIONS

October 2, 1990

Washington, D.C.

## STATE OF NEVADA

## STATUS OF PROGRAM AND DESCRIPTION OF MAJOR ISSUES

The Subcommittee on Nuclear Regulation of the U.S. Senate Committee on Environment and Public Works has requested information from Nevada on the nuclear waste program status and a description of major issues. Rather than presenting a lengthy report, the two attached letters from Nevada to the Department of Energy, along with Nevada's responses to the Subcommittee's questions submitted prior to the Subcommittee's October 2, 1990 hearing, are intended to provide the Subcommittee with the State's views on the high-level nuclear waste disposal program, especially as it relates to the Yucca Mountain candidate repository site, the Department of Energy's implementation of the Nuclear Waste Policy Act, as amended, and certain repository licensing and regulatory issues of interest to the Subcommittee.



STATE OF NEVADA  
EXECUTIVE CHAMBER

Carson City, Nevada 89710

BOB MILLER  
Acting Governor

TELEPHONE  
(702) 863-3479

November 14, 1989

The Honorable James D. Watkins  
Secretary of Energy  
1000 Independence Avenue  
Washington, D.C. 20585

Dear Secretary Watkins:

In view of your announced current effort to restructure the U. S. Department of Energy Nuclear Waste Policy Act program, I believe it is important that I provide you with some of our information and thoughts on the Yucca Mountain Project that may bear on your upcoming decisions.

You will find attached to this letter a brief description of three elements regarding the geotechnical suitability of Yucca Mountain for a geologic repository which the State of Nevada believes should cause the site to be disqualified from further consideration. These are in the areas of (1) the potential for future human intrusion, (2) tectonics, including faulting and vulcanism, and (3) groundwater travel time. Each of these topics has been discussed in past State of Nevada comments on the Draft Environmental Assessment for Yucca Mountain, the Consultation Draft Site Characterization Plan, and most recently, the Site Characterization Plan. However, because of the importance of these issues, I believe they should be brought directly to your attention during your current program evaluation and restructuring.

As you will see from the attached discussion, there is no question that Yucca Mountain is located within a rich mining district that will remain attractive for exploration and development for many years in the future. Because of this location, it is essentially assured that Yucca Mountain and its nearby surroundings, at some time in the future, will be intruded in search of valuable mineral resources, regardless of what any current natural resources evaluation at the site might conservatively conclude. Such a potential for future human intrusion simply cannot be eliminated or even mitigated through either engineering means or passive controls over the long period

the DOE guidelines requiring use of both reasonably available technology and the application of conservative technical judgment cannot be met, again providing sufficient reason now for you to determine, pursuant to the guidelines, that the Yucca Mountain site is disqualified.

In addition to the evidence attached and summarized above which should result in your immediate disqualification of the Yucca Mountain site, there are further factors which I would like to bring to your attention prior to your announcement of decisions regarding restructuring of the Nuclear Waste Policy Act program.

As I am sure you are aware, it has been my belief that the Nevada Legislature's adoption, and my signature of Assembly Joint Resolutions Number 4 and 6, in early 1989, constituted a Notice of Disapproval of the Yucca Mountain site, pursuant to the Nuclear Waste Policy Act. The Notice became effective once these resolutions opposing, and refusing State consent for, a repository were transmitted to the Congress as required by law. In order to reassure myself on this matter, I requested an opinion from the Nevada Attorney General regarding the validity of the resolutions as a Notice of Disapproval. For your information, I have attached a copy of the Attorney General's Opinion, which finds that the Notice is valid and that the Congress failed to respond in the manner required by the Nuclear Waste Policy Act. Therefore, it is Nevada's position that the Yucca Mountain site has been lawfully vetoed, and that the DOE's authority from Congress to pursue the Yucca Mountain site as a nuclear waste repository has terminated.

As you are also aware, there are numerous obstacles that have already, or likely will continue to halt or impede progress on the Yucca Mountain Project, only some of which are within your ability to control and resolve within the Department of Energy. The following are a few examples of obstacles in addition to those discussed in the attachments to this letter: there are at least two unrelated endangered species issues which must be reconciled with the federal agency of jurisdiction; acquisition of protested, although needed water rights from the State of Nevada for the Yucca Mountain project must be accomplished; numerous lawsuits regarding both the DOE's programmatic implementation of the Nuclear Waste Policy Act and the Yucca Mountain Project are pending, any one of which could invalidate key past actions of the DOE and cause significant further delays and reversals; and, there are significant unresolved issues regarding the compatibility of the missions of the Nevada Test Site and the Nellis Air Force Range with acceptable nuclear waste management and isolation at Yucca Mountain.

I must also remind you that it is of more than passing interest that the people of the State, joined by the Legislature, are firmly resolved to oppose the imposition on Nevada of a disposal site for the nation's commercial nuclear waste. The

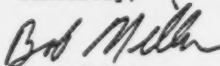


singling out a state for imposition of such an unwanted federal intrusion is without precedent in our nation's history, and rightfully so. I, as Governor, cannot permit Nevada's rights as a state to be so abridged without exhausting every available challenge.

In light of your responsibilities as the federal official charged by law with implementation of the Nuclear Waste Policy Act and prudent administration of the ratepayer-funded Nuclear Waste Fund, I believe you are compelled now to exercise your duty under the Nuclear Waste Policy Act and inform the Congress, and the Governor and legislature of Nevada, that you have removed the Yucca Mountain site from further consideration as a high-level nuclear waste repository.

It is my hope that you will consider seriously the matters I have presented in this letter before proceeding with any decisions to restructure the Nuclear Waste Policy Act program and the Yucca Mountain Project.

Sincerely,



Bob Miller  
Governor

Attachments (2)

BOB MILLER  
Acting Governor

STATE OF NEVADA

ROBERT R. LOUX  
Executive Director



AGENCY FOR NUCLEAR PROJECTS  
NUCLEAR WASTE PROJECT OFFICE

Capitol Complex  
Carson City, Nevada 89710  
(702) 885-3744

January 12, 1990

Mr. Samuel Rousso  
Acting Director  
United States Department of Energy  
Office of Civilian Radioactive  
Waste Management, RW-1  
1000 Independence Avenue, S.W.  
Washington, D.C. 20585

Dear Mr. Rousso:

RE: REPORT TO CONGRESS ON REASSESSMENT OF THE CIVILIAN RADIOACTIVE  
WASTE MANAGEMENT PROGRAM, DOE/RW-0247, November 30, 1989.

Governor Bob Miller has asked that I respond to Secretary Watkins' November 29, 1989, letter in which he requested that the Governor forward comments to you on the proposed schedules contained in this Report.

Given the significance and scope of the Secretary's Report and plan for restructuring the Department's high-level nuclear waste program, and his having "concluded that the program cannot be effectively executed in its present form," I have taken the liberty to provide comprehensive comment on the Report, rather than limiting Nevada's comments to the schedules, as requested. You will find Nevada's detailed comments attached to this letter.

The Secretary's stated goals in developing the plan contained within the Report are as follows:

- \* Protecting public health and safety and the quality of the environment in the management and disposal of spent fuel and high-level waste.
- \* Developing an NRC-licensed geologic repository for the permanent disposal of spent fuel and high-level waste.
- \* Beginning the operation of the waste-management system as soon as practicable in order to be able to accept spent fuel and high-level waste for disposal at a significant rate during the early years of operation.

- \* Establishing public confidence that the management of radioactive waste is not an obstacle to the nuclear energy option.

The Report describes the plan the Secretary has developed to achieve these goals. There are three stated major elements of the plan:

- \* Developing and implementing a new management structure.
- \* Gaining access to the Yucca Mountain candidate site and initiating comprehensive scientific investigations as the focus of site characterization.
- \* Developing options for ensuring the timely acceptance of spent fuel through the establishment of monitored retrievable storage (MRS).

In the course of reviewing the Report, we also reviewed the Department's December 20, 1989, presentation to the Nuclear Regulatory Commission, by Leo Duffy, Special Assistant to the Secretary for Coordination of DOE Waste Management. In this presentation he described the Secretary's plan to the Commissioners and elaborated on certain regulatory aspects of the plan, as they relate to required NRC facility licensing for waste management and disposal.

The Secretary's plan provides a partial framework for implementing an entirely new high-level nuclear waste management and disposal program under the Nuclear Waste Policy Act, as amended. However, the success of the plan appears to rely primarily on a number of elements that are not within the control of the Secretary. These include Congressional action to remove existing linkages between repository siting and MRS facility siting and development for interim spent nuclear fuel storage; licensing and regulatory deferrals and modifications by the NRC and Environmental Protection Agency; and DOE prevailing in litigation against Nevada for access to the Yucca Mountain site. In fact, the only major point of reliance that is within the control of the Secretary is the planned restructuring of the program management within the Department of Energy.

Mr. Duffy's presentation to the NRC was most revealing in its bold and blatant suggestion that "there is a need for a fresh look at the regulatory framework." His further remarks clearly indicate DOE's concerns that NRC and EPA licensing regulations could "undermine" the DOE's ability to develop a nuclear waste repository, and that prescriptive health and safety and environmental protection regulations are premature "until such time as we learn more about the capabilities of the entire waste isolation system, particularly the site."

In addition to openly suggesting to the Commission that its and EPA's licensing regulations be molded to fit the Yucca Mountain site, there was the further, equally astounding proposal for "collaborative interaction" among DOE, the electric utilities, the State of Nevada, and the NRC in developing repository licensing regulations and criteria as well as interpretation of the regulations.

Taken as a whole, the DOE's approach to resolving the known and expected technical inadequacies of the Yucca Mountain site and their fatal impact on repository licensing is nothing less than an arrogant invasion of regulatory objectivity and integrity, with the goal of compromising otherwise required health and safety and environmental protection standards. This hidden DOE agenda only serves to discredit and undermine the Secretary's lofty statements of his goals in the Report.

The Report states that a detailed discussion of the plan will be presented by DOE in a revised program Mission Plan, which will be issued for public review and comment by June 1990. The Nuclear Waste Policy Act requires that a comprehensive Mission Plan for the entire waste management and disposal program be submitted to Congress prior to DOE's implementation of its program. No such plan has been submitted by DOE since before Congress adopted the 1987 amendments to the Nuclear Waste Policy Act, which among other things singled out the Yucca Mountain site as the only site to be investigated for high-level nuclear waste disposal. The lack of a valid Mission Plan, coupled with the enormity of the implications of the Secretary's Report as evidenced above, requires that DOE submit a new, comprehensive program Mission Plan, as provided by the Act, before proceeding with implementation of the Secretary's new plan.

Furthermore, since the Secretary's plan restructures DOE's planned site characterization program at Yucca Mountain, the existing Site Characterization Plan should be considered invalid until a revised program Mission Plan has been accepted by Congress, and a new, conforming Site Characterization Plan has been drafted and submitted for public review, as required by the Nuclear Waste Policy Act.

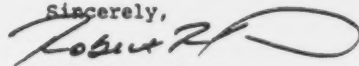
Nevada firmly believes that it is imprudent and unlawful for the DOE to continue to pursue siting and developing a high-level nuclear waste disposal facility at Yucca Mountain. As you are aware, Governor Miller informed Secretary Watkins on November 14, 1989, as this Office has informed DOE in the past, that sufficient information exists about the Yucca Mountain site for it to be disqualified under the DOE's own repository siting guidelines. This and Nevada's belief that State legislative actions have resulted in a successful veto of the Yucca Mountain site, under the Nuclear

Waste Policy Act, are issues in a lawsuit filed against the Secretary of Energy this month by the Nevada Attorney General.

Notwithstanding our position regarding the invalidity of Yucca Mountain as a potential repository site, we are providing the attached comments on the Secretary's report and plan in the interest of furthering the Nation's future ability to resolve its ever-increasing nuclear waste problems. The intent of these comments is to point out that this latest DOE approach to developing a national nuclear waste management and disposal program is incomplete, misdirected, and demonstrates an arrogant and willful misunderstanding of the regulators' proper role in protecting health and safety and the environment. In its conception, the approach represents nothing more than yet another patchwork attempt by DOE to "fix" the most obvious, while ignoring the most fundamental problems of the program.

Governor Miller has informed me that he looks forward to Secretary Watkins' response to the comments provided in this letter and attachment.

Sincerely,



Robert R. Loux  
Executive Director

RRL:cs  
attachment

cc: Governor Bob Miller  
Admiral Watkins  
Nevada Congressional Delegation



STATE OF NEVADA  
Responses to Questions

1. What are Nevada's views on the steps DOE is taking to commence site characterization?

Nevada believes that a number of steps and activities are required to be completed before DOE can, or should, commence site characterization. These include the following:

A.) Quality Assurance

Nevada believes that DOE must have a fully qualified and NRC-accepted quality assurance program plan in place for the entire program that is demonstrated to be effective prior to the commencement of any site characterization activities. DOE is making progress toward this end.

B.) Mission Plan

The development of a new mission plan (pursuant to Sec. 301 of the NWPA) that incorporates the major changes that have taken place in the program, some even prior to passage of the Nuclear Waste Amendments Act of 1987, is a necessity before DOE can commence site characterization. The current mission plan was finalized in June 1985 with an amendment published in June 1987. Section 301 of the Nuclear Waste Policy Act requires the Secretary to "prepare a comprehensive report, to be known as the mission plan, which shall provide an informational basis sufficient to permit informed decisions to be made in carrying out the repository program..." Major changes have taken place in the program, including the adoption of the Amendments Act in 1987, that require a new mission plan consistent with the Section 301 list of contents. Both the Secretary, in his November, 1989, 60-Day Report, and the new director of the Office of Civilian Radioactive Waste Management, John Bartlett, have committed the DOE to the development of a new mission plan; however, it is not clear when that document will be prepared (the Secretary had committed it for June 1990). DOE apparently believes it can proceed with site characterization before a new mission plan is in place.

C.) Site Suitability Determination

The Nuclear Waste Policy Act requires DOE to make a site suitability determination of the Yucca Mountain candidate site based on the Siting Guidelines (10 CFR 960). Such

determination is to be based upon the qualifying and disqualifying conditions required by Section 112 of the Act (not on the site performance regulations and standards included in the licensing regulations of the NRC and EPA). According to the DOE, they have spent over \$1 billion at Yucca Mountain since 1979, and Nevada believes that this data base must be evaluated against the Siting Guidelines' disqualifying conditions to determine if the site is disqualified. This process is clearly not contained in DOE's Site Characterization Plan, except as a final pro-forma step after determining overall projected site performance pursuant to licensing regulations at the end of site characterization. The DOE currently has no system or method in place to perform such an analysis. Therefore, Nevada believes that prior to the commencement of site characterization DOE must develop a system or process to evaluate the existing site data against the Siting Guidelines and subject the existing data to such an examination to determine if the site is disqualified at this time. Further, throughout site characterization, in the semi-annual progress reports required by Section 113 of the Act, DOE should repeat the same process, comparing the data base that exists at that time against the Siting Guidelines to determine if the site has been disqualified at any time during that period of site characterization.

While the Secretary, in his 60-Day Report to Congress, committed the DOE to the development of a system to evaluate the suitability of the Yucca Mountain site, it is not clear when or how the DOE intends to use such a process, or what methodology will be employed. However, it is clear that the intent is to evaluate site suitability relative to compliance with NRC/EPA performance-based licensing requirements rather than the DOE guidelines which screen for whether the existing or expected conditions at the site require its disqualification.

#### D.) Site Characterization Plan

It is Nevada's position that the changes that have taken place in the DOE program since the issuance of the Site Characterization Plan in December 1988 and that are likely to take place before DOE can begin actual site characterization are such that a new Site Characterization Plan must be developed and resubmitted for public review and comment. The Secretary of Energy, in his 60-Day Report to Congress, after reviewing the existing program, concluded, "... the (repository) program cannot be effectively executed in its present form...", "at least in part because of the planned site

characterization program. As discussed previously, commitments have been made by the Secretary to refocus early site characterization activities toward site suitability determinations and by the Secretary and the new OCRWM director to initiate the development of a new mission plan. Both of these commitments, together with other likely changes in the program resulting from the exploratory shaft facility alternatives study and the surface-based test plan prioritization study, necessitate that DOE develop an amended site characterization plan prior to commencing site characterization. DOE is not planning to take this step.

E.) State Funding for Oversight and Access to Yucca Mountain

Nevada believes that the State must be provided adequate funds for the oversight of the DOE program as mandated by the Nuclear Waste Policy Act and in Court opinions regarding the State's independent oversight responsibilities. The State must also be afforded independent and unfettered access to the Yucca Mountain site to conduct its oversight and evaluation activities. In 1984, the DOE denied funds to Nevada to carry independent data gathering activities at Yucca Mountain. After fruitless negotiations, the State sued the DOE in the 9th U.S. Circuit Court of Appeals, which affirmed the right to engage in such activities. From 1985, the date of the Court's decision, to present the DOE has, through piecemealed funding or refusing access to the site, prevented Nevada from conducting its oversight activities. Recently, access to adequate funding has been curtailed further by Congressional appropriations.

F.) DOE must respond to Nevada's comments on DOE's Site Characterization Plan

DOE released its Site Characterization Plan in December 1988 for public review and comment, conducted public hearings in March 1989 and closed the comment period on June 1, 1989. DOE provided responses to oral comments received in the public hearings in August 1990, some 16 months after the hearings, but has yet to respond to the written comments provided by the public. The State of Nevada, at DOE's request, provided written comments on DOE's proposed exploratory shaft facility design and location in June 1989, and on the overall Site Characterization Plan in September 1989. To date no responses have been made to either set of comments, although DOE appears to be planning to release a response document in March 1991, nearly two years after receipt of Nevada's initial comments. Nevada believes that DOE cannot begin site characterization until all of these

comments have been adequately and substantively responded to, and where appropriate, incorporated into an amended draft Site Characterization Plan.

G.) DOE must have an environmental program in place

Before beginning site characterization activities, DOE must demonstrate that it has an effective environmental program in place to assure that the impacts of site characterization are minimized, as required by the NWSA. The NWSA requires that this program plan be developed in consultation with Nevada.

2.) What are Nevada's views on the DOE site characterization program?

Nevada believes that the DOE approach to characterizing the Yucca Mountain site, as described in DOE's Site Characterization Plan, should be significantly revised before it can be viewed as a credible basis for evaluating the suitability of the site to host a high-level nuclear waste repository. The SCP exhibits three fundamental flaws in its conception that will be difficult, if not impossible, to rectify once implementation of the process is initiated.

The first is that the plan fails to provide a program that places an emphasis on the early examination of critical geotechnical issues that could lead, or may have already led to disqualification of the site under DOE's own General Guidelines for the Recommendation of Sites for the Nuclear Waste Repositories (10 CFR 960). An early concentrated data collection effort to improve confidence in the understanding of potential adverse impacts on waste isolation resulting from recurring faulting and volcanism does not appear in the plan. Also lacking is a plan for an early, comprehensive natural resources assessment to project the likelihood of future human intrusion compromising waste isolation at the site.

This is of great importance because of the location of Yucca Mountain in a proven mining district. Furthermore, the results of a comprehensive natural resources evaluation regarding the potential for future human intrusion are independent of any other waste isolation performance assessments of the site. If significant potential exists for future natural resources exploration or extraction, there is nothing DOE can do in repository design to assure effective compensation for this adverse condition over the long period of required waste isolation. A high potential for future human intrusion, resulting from the known presence of valued natural

resources or the lack of sufficient data regarding natural resources at the site, is alone sufficient reason to disqualify the site.

A second fundamental flaw in the SCP is its failure to adequately integrate the planned study and data collection activities. This failure will result in the inability to carry out an ongoing iterative performance assessment of the site that should become more certain through time with the addition of new data-based information as it is developed. The failure to adequately integrate site characterization activities also results in precluding the ability to evaluate the validity of alternative conceptual models for the site geohydrology as data are being collected and additional data collection activities are being planned. This reinforces our and the NRC's earlier concern that the DOE's site characterization approach is more one designed to confirm its own preconceived notion of a simplified site model than it is to determine through site investigations the most likely conceptual model for the site that can be supported by objective and comprehensive data collection and analysis.

The third fundamental flaw of the SCP is the imposition of an unrealistic schedule for the period of site investigation and data collection prior to a determination by the DOE of the site's suitability for submission of a repository license application to the NRC. As we have described to DOE in the past, the schedule constraint appears to be driving the heavy reliance on analytical models in determining site suitability, rather than determining suitability through the use of empirical findings from on-site data collection. For example, it appears that vastly insufficient time has been allocated for developing and validating (with site data) first-of-a-kind unsaturated zone hydrologic models for use in performance assessment. In fact, our review indicates that sufficient duration of time is not provided for adequate execution of some critical hydrologic tests. It also appears that the general intent in the SCP is to determine site suitability on the basis of complex generic models that are asserted by DOE to be valid for the site, rather than using a sufficient combination of Yucca Mountain site data and models validated for site-specific use.

The root cause of the conceptual flaws in the SCP that are pointed out above has remained unchanged throughout the process of DOE's evaluation of Yucca Mountain as a potential high-level nuclear repository site. In simplest terms, the DOE continues to assume the



suitability of the site, and this SCP, only the latest of DOE's plans for site investigations, is designed to provide no more information than is necessary for the DOE to believe its assumption has been confirmed, only because it did not discover any factors or conditions that would clearly disqualify the site. This approach is contrary to the requirements of the NRC repository licensing process in which DOE must prove its case for the suitability of the site through a rigorous program of scientific investigation. It is wholly improper and inadequate for the DOE to assert the suitability of the site on the basis of its failure to have discovered that the site is unsuitable. Furthermore, DOE's assumption of suitability is certainly premature and without basis in view of the fact that the guiding EPA regulations for repository performance do not even exist at this time.

In summary, it is Nevada's belief, based upon our review of the Site Characterization Plan for the Yucca Mountain site, that the SCP is an inadequate basis for investigating the suitability of the site for safe, long-term isolation of highly radioactive wastes. The SCP does not incorporate the basic elements of a dedicated and credible scientific investigation in which alternative working hypotheses are objectively evaluated against a comprehensive data base in order to gain a supportable understanding of the geohydrologic system, and the results of that evaluation are then brought forward to a rigorous test against criteria which must be met in order to determine site suitability. The SCP, in fact, does just the opposite. Its thrust is one that minimizes scientific inquiry and investigation, while asserting that as long as no specific bit of information emerges that would obviously disqualify the site in a regulatory review, the site must be determined suitable. This approach lacks scientific merit, and is not supportable under existing regulations.

- 3.) The NRC staff has stated that "a rigorous application of the EPA standards cannot be implemented in a licensing review." Additionally, the NRC's Advisory Committee on Nuclear Waste (ACNW) has stated that the standards may be unrealistic, are overly stringent, and will be wasteful of resources with little commensurate benefit. Does the State of Nevada agree with the NRC staff or the ACNW? Does Nevada believe that it will be possible for DOE to demonstrate compliance with the EPA probabilistic standards in a licensing proceeding for Yucca Mountain?

Before responding to this question, it is necessary to point out that Part B of the EPA standards regarding disposal, was remanded by the Court, and EPA is now in

the process of developing information for its repromulgation. In reviewing various comments and discussions regarding the EPA standard, some are addressed to the standard as promulgated in 1985, some are addressed to EPA's Working Paper 2 (issued for discussion earlier this year), and it is not clear what specific document some comments reference.

It should also be remembered that the original 1985 promulgation of the EPA's 40 CFR 191 was more than five years in the making. It went through an extended internal review, a public comment and interactive public hearing process with both EPA and NRC represented on the hearing panels (raising issues and questions to those giving testimony), and there were 24 working papers issued for discussion by EPA prior to the standard's final promulgation.

Now, just five years later, there seems to be unrest among some sectors with some of the basic underlying principles established in that standard, which, incidentally, were not the issues that led to the Court's 1987 remand of the rule. It should also be noted that EPA chose not to appeal the Court's remand in 1987.

We can only speculate that the raising of concerns about whether the fundamentals of the standard are acceptable, and whether it is possible to demonstrate compliance at some acceptable level, are directly related to government managers' and advisors' concerns about two geologic repository sites (Yucca Mountain and WIPP) that are now under consideration, both of which emerged from a political selection process, without the benefit of rigorous scientific screening. Both sites have geologic complications that were either ignored or understated in the earlier decisions, but now must be dealt with if the sites are to remain viable candidates for waste isolation use.

It was not very long ago that Nevada and others questioned how a credible Site Characterization Plan could be developed for Yucca Mountain without EPA standards in place. The retort from DOE managers was, "We can meet any standard." However, the scientific staff personnel were considerably more cautious in their responses. In recent months, there seems to have been a reversal. The managers and advisors are now concerned about whether the standards are appropriate and can be complied with, while - at least at Yucca Mountain - the scientists are expressing some confidence from preliminary work that the standards can be met.

We raise these points only to put the current discussion of EPA's standard into the context of the larger problems of the waste disposal program, rather than having them become perceived as the center or source of the problem.

Regarding the comments of the NRC and ACNW, they too should be placed in a broader context. The EPA standard is intended to be generic for geologic repositories (as it should be), but it is difficult, if not impossible, to objectively review such a standard when one has at least a foundation level of knowledge of the only two geologic sites to which they might be applied in the foreseeable future.

The NRC comments acknowledge difficulties with rigorous application of the standard, but also suggest the difficulties are closely tied to the relative complexity and geologic activity of a site under consideration. As is well acknowledged, Yucca Mountain is geologically complex, and in a setting in North America that is considered geologically active. The NRC's comments, also, may not be fully responsive to the level of flexibility EPA appears to have intended in the application of the standard.

The NRC has been shown some difficulties in rigorous application of its repository licensing rule (10 CFR Part 60), especially in the areas of treatment of anticipated and unanticipated processes and events, and in compliance with quantitative subsystem performance requirements. In defense of its own rule, it points to the flexibility in application (correctly) intended and embodied in the rule. The NRC rule, also, is intended to be a generic licensing rule.

The ACNW's comments appear to be generally reactive to EPA's Working Paper 2. Overall they seem to reflect the opinion held by the committee's members and staff who believe repository license goals, objectives and standards need be no more rigorous or stringent than those applied in nuclear reactor licensing. We simply disagree, especially for this first-of-a-kind venture which must break new scientific and engineering ground with long-term, essentially irreversible, consequences.

As should be evident, we believe the information regarding the site's existing conditions should cause Yucca Mountain's disqualification under the DOE's Siting Guidelines (10 CFR Part 960). Even those who disagree with this position, acknowledge that the existing and known factors and conditions we cite are at least adverse to waste isolation performance. In addition, the

complexity of the site is an added adverse factor in gaining confidence in the site's waste isolation capabilities through performance assessment.

Therefore, first, we do not believe Yucca Mountain is acceptable for application of the EPA standard, since it fails a much less rigorous level of screening. Second, because of its complexity and geologic instability, it likely would not be possible to demonstrate its compliance with the standard (and rightly so). And finally, even if all other problems were removed, it may not be possible for DOE to demonstrate compliance because of other problems peculiar to DOE's management and technical approach to implementing the waste program, which have nothing to do with the site or the regulations.

- 4.) Will it be possible to meet the EPA standards at any other site?

The issue of whether the EPA standards can be met at a site other than Yucca Mountain is uncertain. While there appears to be a growing consensus that the Yucca Mountain site is likely not licensable under the EPA standards as they were originally promulgated, it cannot be shown that they cannot be met elsewhere. The complications and uncertainties at Yucca Mountain are not necessarily representative of conditions that may be found at other geologic settings. Before considering whether the standards should be rejected as unworkable, they should be given a fair test under site conditions that are not burdened with such complications as those already known to exist at Yucca Mountain. These unavoidable complications include such intractable elements as our lack of experience with hydrologic modelling and validation in the unsaturated zone, and with the unknown, and maybe unpredictable, effects and limits of coupled processes in this tectonically active setting. Both of these areas of complication may be impossible to resolve and understand in the context of their overall impact on repository performance with any real degree of confidence. Sites in other geologic settings with a more homogeneous rock body - with which the world has a much greater experience - such as granite, offer a greater likelihood of meeting objective long term performance standards.

- 5.) What are Nevada's views on the conclusion of the National Research Council of the National Academy of Sciences that "the U.S. program as conceived and implemented over the past decade is unlikely to succeed?"

Nevada is in general agreement with the National Research Council's conclusion about the current U.S. program, but likely for different reasons. While the Council's concern is based, in large measure, on the EPA standards and the licensability of Yucca Mountain or any other site under those standards, Nevada's concern is over the method in which the U.S. program has (or has not) engaged in site screening and in determining the suitability of a site. For example, DOE assured the Congress in 1986 and 1987 that the Yucca Mountain site would be found suitable and, in testimony to the U.S. Senate, the Yucca Mountain project manager stated he could not conceive of anything that would cause them to change their mind about it. Now some major concerns have been raised by the Council, some of the staff of the NRC, and by some DOE scientists, in addition to the State, that the Yucca Mountain site is likely not licensable. In simplest terms, DOE oversold the merits and understated the defects of Yucca Mountain. And now, not surprisingly, the scientists cannot deliver at the level advertised by DOE management.

Much greater attention must be paid to conducting extensive site screening and suitability determinations, rather than focusing upon licensing. Two decisions must be made for siting a high level nuclear waste repository: First the site must be determined to be suitable; and second, it must be found licensable. And, the standards for the two decisions are not the same. The Nuclear Waste Policy Act intended that DOE determine the suitability of the site based upon the Act's required guidelines for site recommendation. These guidelines, by law, require that there be factors that not only qualify the site, but also disqualify the site based on site characteristics, rather than the site's expected waste isolation performance. The Act required these guidelines to be stringent because they were intended by Congress to screen out sites with characteristics so adverse that the site should not be considered further. It should be recognized that the Yucca Mountain site has yet to demonstrate that it has passed this initial test, despite the expenditure of now over \$1 billion on this site. DOE simply has no system or method in hand to make this analysis. Therefore, Nevada believes that the current program is unlikely to succeed, but not because of EPA standards or NRC regulations. It is likely not to succeed because Yucca Mountain was selected as the only site to be characterized without sufficient site screening to justify reasonable confidence that it could be found even suitable for license application. The approach advocated by this Committee in 1987, during the debate over the Nuclear Waste Policy Amendments Act, to



conduct extensive surface work at the three candidate sites prior to making a decision on the single site to be characterized (to determine licensability) would have, in Nevada's estimation, provided a much greater degree of confidence that the site ultimately selected for detailed site characterization would be found licensable. The approach that was finally selected and embodied in the Nuclear Waste Amendments Act relied on the promises and assurances of the DOE, which we believe are unfounded and are likely to remain unfulfilled.

6.) More specifically, what are Nevada's views on each of the recommendations of the report?

1. Nevada is in general agreement with the recommendation that the schedule embodied in the NWPA should be flexible and more realistic.
2. Nevada is not in agreement with the recommendation that EPA reconsider detailed performance standards and that EPA reexamine the use of quantitative probabilistic release criteria, as explained in response to previous questions.
3. Nevada does not believe that the Nuclear Regulatory Commission should reconsider the detailed licensing requirements for a repository, as the report recommends. This has been explained in response to a previous question.
4. Nevada is in general agreement with the report's recommendation that DOE should become a more responsive player in the overall program.
5. Nevada agrees that DOE should make greater use of conservative engineering design.
6. Nevada agrees that DOE should participate more actively in international studies and forums.
7. Nevada strongly agrees with the report's recommendation that contingency planning for other sites and options be pursued.

**Testimony of Allen J. Keesler, Jr.  
on behalf of  
ACORD, ANEC, EEI, and UWASTE  
before the  
Subcommittee on Nuclear Regulation  
of the  
Senate Committee on Environment and Public Works  
October 2, 1990**

My name is Allen J. Keesler, Jr., and I am President and Chief Executive Officer of Florida Power Corporation. Florida Power owns and operates the Crystal River 3 commercial nuclear power plant. I also have the privilege of serving as the chairman of the American Committee on Radwaste Disposal (ACORD), the senior utility industry body on nuclear waste and transportation issues. This testimony is also being given on behalf of the American Nuclear Energy Council (ANEC), the Edison Electric Institute (EEI), and the Utility Nuclear Waste and Transportation Program (EEI/UWASTE). Mr. Chairman, I appreciate your and the subcommittee's keen interest in this program, and I thank you for the invitation to appear before you.

As you are aware, the ongoing events in the Middle East have once again demonstrated the need for a national energy strategy that encourages the production of secure, domestic sources of energy. We believe that any national energy strategy must rely on nuclear energy to meet our growing electrical requirements, provide for energy security and promote environmental progress.

Mr. Chairman, I am encouraged that, in your opening statement at the Subcommittee's recent hearing on standardization and licensing reform, you stated that the cornerstone of any federal energy policy was the federal government's responsibility to remove unnecessary obstacles to the development and use of domestic sources of energy. We strongly concur with this view and hope that we will be able to work with you and the Subcommittee to address the institutional impediments that are inhibiting nuclear energy from contributing its full potential to our nation's growing national energy requirements.

Given the urgent need to develop a national energy strategy that encourages the production of secure, domestic energy sources, the nation has an enormous interest in ensuring the timely implementation of the federal civilian high-level waste program. For the last 30 years, utilities have safely stored spent fuel at their sites. Nonetheless, there has always been the need to develop a permanent disposal system. Under the Nuclear Waste Policy Act of 1982 (NWPA), as amended, the Federal government has the responsibility to ensure that the spent fuel from the generation of electricity is disposed of in a safe, environmentally sound, cost effective and timely manner. Continued progress to site and

operate a high-level waste disposal facility is extremely important if we are to maintain nuclear generation as an option to meet future electrical demand and if we are to promote the nation's energy security and continued environmental progress.

The timely implementation of the nuclear waste program is long overdue. Initiated by President Carter more than 10 years ago after exhaustive inter-agency review, it has been supported by both Democratic and Republican administrations.

In 1983, Florida Power Corporation, together with other utilities owning and operating nuclear energy plants, entered into contracts with the Department of Energy (DOE) pursuant to the NWPA. Under the Act, Congress created a road map and a timetable for siting, licensing and constructing a geologic repository for the disposal of the spent nuclear fuel generated by this country's commercial nuclear energy plants. Our obligation under the contract was to pay the full cost for disposing of the spent fuel. All nuclear utilities are doing this by annually paying for each nuclear plant approximately \$500 million of ratepayer's monies into the Nuclear Waste Fund. Payments by all the nuclear utilities, along with several non-utility companies that own small quantities of spent fuel, as of the end of 1989, exceeded \$4 billion. Florida Power Corporation and Florida Power and Light Company paid over \$23 million in 1990 and have paid approximately \$311 million since payments began in 1983.<sup>1</sup> DOE's obligation under the contract was to implement the program outlined in the Nuclear Waste Policy Act and to begin to accept spent nuclear fuel by January 31, 1998. In addition, the DOE Defense Programs are required by the Act to pay for disposal of their waste. To date, no such payment has been made.

My testimony today discusses some of the areas where DOE's high-level waste program has been improved and others where improvement is still needed. My perceptions are based on my role as Chairman of ACORD and on my visit this July (with other industry leaders) to the Yucca Mountain site. DOE appears to be ready to begin characterizing the Yucca Mountain site. However, Congress may have to act again so that DOE can gain access to the site.

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<sup>1</sup>According to the National Association of Regulatory Utility Commissioners, the ten states with the highest payments are: Illinois - \$752 million; North Carolina - \$470 million; New York - \$421 million; Pennsylvania - \$317 million; California - \$315 million; Florida - \$311 million; New Jersey - \$273 million; Virginia - \$259 million; Alabama - \$255 million; and Connecticut - \$253 million. (These totals include payments plus any debt and interest.)

## OVERALL STATUS OF THE DOE PROGRAM

### **DOE Priorities**

The high-level waste program, because of its technical complexity and sensitive institutional issues, cannot be implemented without the direction, interest and support of senior DOE management. No matter how skilled, no OCRWM Director could conduct the waste program by himself. Secretary Watkins and his team must continue to provide the necessary leadership. Thus far, the Secretary and the Director have done an admirable job of energizing the Department and moving the program forward.

Last November the Secretary issued a Report to Congress on Reassessment of the Civilian Radioactive Waste Management Program (Report). The Report was an objective and realistic appraisal of DOE's program. In the Report, the Secretary laid out DOE's first realistic schedule for the program, and also recognized many of the program's shortcomings. In almost all cases, the utility industry agreed with the Secretary's assessment and endorsed his proposed course of action. (The industry's detailed response to this Report provided a description of our specific comments on the program. A copy of the industry response is attached.)\* Another positive development for the DOE high-level waste program was the confirmation of Dr. John W. Bartlett as the Director of the Office of Civilian Radioactive Waste Management (OCRWM). Dr. Bartlett possesses the necessary background and experience to understand the complexities of this first-of-a-kind program. The industry has been impressed with his efforts to date.

### **Recent Progress**

The waste program has recently made significant progress in some areas. These benchmarks of progress include:

- The Secretary's November 29, 1989 Report to Congress.
- The nomination and confirmation of Dr. Bartlett as Director, OCRWM.
- Dr. Bartlett's recent reorganization of the OCRWM staff and the pending reorganization of the program's contractors.
- The unfortunate but necessary litigation brought by the federal government to secure the necessary state and environmental permits.
- The favorable, definitive decision rendered by the Ninth Circuit in Nevada v. Watkins.
- DOE's acceptance of the need for an early evaluation of the site for potentially disqualifying features.
- Successful quality assurance audits for seven of the major contractors and national labs participating in the project.

\* The attachment referred to has been retained in committee files.

- The nomination and confirmation of David Leroy as Nuclear Waste Negotiator.

Nonetheless, the program still has a long way to go. While the leadership and management at DOE has greatly improved, the agency must still successfully deal with several major problem areas. It must also be able to show that it has achieved tangible, demonstrable milestones toward a waste disposal system.

### **MAJOR ISSUES FACING THE PROGRAM**

#### **Access to Yucca Mountain**

The State of Nevada has raised technical concerns that it believes disqualify the Yucca Mountain site. Yet Nevada refuses to allow any scientific investigation of the site to determine whether the concerns are valid. We believe that the best way to resolve whether or not the site is qualified is to allow DOE access to the site to conduct a thorough scientific evaluation. Nevada's refusal to allow access to the site has unfortunately led to litigation.

On September 19, a three judge panel of the Ninth Circuit Court of Appeals ruled unanimously to reject Nevada's challenges to DOE actions and the constitutionality of the NWPA. The court stated that Nevada's attempted 1989 legislative veto was premature and "stands as an obstacle to the accomplishment of the full purposes and objectives of Congress." Additionally, the court found that "any legislation which frustrates the full effectiveness of federal law is rendered invalid by the Supremacy Clause."

In related litigation, DOE has sued the state of Nevada in Federal District Court for its refusal to issue environmental permits. DOE needs these permits to conduct the scientific studies that will determine if the site is suitable for the repository. That litigation, stayed in the District Court pending the outcome in the Court of Appeals decision, should now go forward.

The permits involved in the District Court litigation represent only a few of the many permits DOE will need. The project requires over 30 environmental permits, some of which may need to be renewed each year. Getting the permits promises to be a difficult task. In one recent example of the state's lack of cooperation, the Nevada Department of Wildlife has denied DOE permission and withheld a permit, routinely renewed each year, to study the Mojave Desert tortoise at the Yucca Mountain site. This was done even though the U.S. Fish and Wildlife Service has issued a permit to DOE to handle endangered species. Additionally, the DOE has 16 years of experience handling the desert tortoises at the Nevada Test Site.

It should be noted that there are some Nevadans that support characterization of the Yucca Mountain site, including the Nevada Nuclear Waste Study Committee, with



membership including over 9,000 Nevadans, and the Southern Nevada Building Trades Council, which represents the interests of 15 building trade unions comprised of 30,000 southern Nevadans.

It is our hope that the State of Nevada and DOE can cooperatively resolve the dispute over the permits. Failing that, Congress should act swiftly to provide DOE with all the necessary authority to access the site and to begin and continue site characterization. This program is critical to the continued use of nuclear energy, to the nation's energy security, and to the country's continued environmental progress.

#### **Monitored Retrievable Storage Facility**

The Department needs to continue in its effort to develop a useful MRS. We applaud the President's nomination and the Senate's confirmation of Mr. David Leroy as Nuclear Waste Negotiator. Mr. Leroy will serve a critical role in locating an MRS site, and possibly also in negotiating an acceptable agreement concerning the repository. We hope that he is successful in his task, and that he is able to open a productive and earnest dialogue with any relevant state or Indian tribe. In order to obtain the maximum benefits from an MRS, the current construction, operation, and capacity linkages to the repository need to be modified. One of Mr. Leroy's major tasks will be to develop, along with one or more states or Indian tribes, mutually acceptable modifications to the existing linkages.

#### **ANSWERS TO SPECIFIC QUESTIONS ASKED BY THE SUBCOMMITTEE**

##### **1. Is DOE's site characterization program at Yucca Mountain technically sound?**

The DOE program is unquestionably technically sound. DOE's Site Characterization Plan (SCP) calls for the completion of nearly every known geoscientific test in search of information about Yucca Mountain. There is no doubt that this is a well-designed, comprehensive program. This was reaffirmed in my mind when I visited the Yucca Mountain site in July, and spoke with the DOE site managers and the scientific experts at work there.

The nuclear industry's major concern with the program has been that DOE would be expending funds on what might be unnecessary studies, and not fully evaluating the data until after the completion of at least seven years of data collection. The utility industry has encouraged DOE to prioritize their site characterization activities with the hope that disqualifying conditions, if they exist, would be identified as early as possible. This is an approach that Nevada has endorsed. DOE has recently begun to develop a plan to address these problems. We therefore feel more confident that DOE is now moving in the proper direction.

In addition, to ensure that the DOE program remains sound, there is adequate scientific and technical oversight by NRC and its Advisory Committee on Nuclear Waste, the Technical Review Board, the National Academy of Sciences, the Nevada Nuclear Waste Study Board, etc. We encourage more participation in the program by the Nevada scientific and academic communities.

**2. Is there sufficient cost control and contractor accountability?**

Until recently, it was the industry's opinion that there was not enough cost control or contractor accountability. However, with the release of the Secretary's Report, the Director's reorganization plan, and the pending finalization of the Management and Operations contract, we are hopeful that more effective cost control and contractor accountability will be implemented. Many of the problems in this area are caused by the excessive, unmanageable number of national laboratories and other private contractors. As part of the plan to bring in the Management and Operations contractor, we understand that DOE will trim its participants to a more manageable number.

**3. Is the EPA standard unrealistic, too stringent, and not capable of implementation?**

The National Academy of Sciences/National Research Council Board on Radioactive Waste Management's recent international symposium on geologic repository licensing raised questions concerning the Environmental Protection Agency's (EPA) high-level waste standard (40 CFR Part 191). The industry has long shared many of these concerns. The standard is much more stringent than other comparable standards. This unnecessary stringency would likely lead to excessive expenditures of time, money and effort. Fortunately, the National Research Council has set a scientific discussion in motion that is aimed at resolving this issue. This process must be allowed to continue. We encourage EPA to assign the appropriate resources to this effort.

**4. Is, as the National Research Council says, the US program, as conceived and implemented over the past decade, unlikely to succeed?**

At the time of their retreat two years ago, the Council developed a concern with specific portions of the program that led it to conclude that the program "as conceived and implemented over the last decade" might not succeed. This concern was based upon the "inflexible" DOE program, which was "poorly matched to the technical task at hand." At that time, our industry had similar concerns. As described above, however, DOE has implemented numerous positive changes to the

program. Secretary Watkins has given the program a higher level of attention and more focus than it previously had. OCRWM Director Bartlett has, in his brief tenure, already devised significant management improvements. Therefore, the DOE program of today is clearly not the same as the program of the 1980s. DOE is profitably implementing the guidance it has received. As the Council itself points out, "There is worldwide scientific consensus that deep geologic disposal ... is the best option for disposing of high-level radioactive waste. There is no scientific or technical reason to think that a satisfactory geological repository cannot be built." The program can succeed.

#### 5. Industry views on the specific recommendations of the report.

The National Research Council performed a valuable service to the nation by bringing into focus the scientific community's concerns over the high-level waste program and related regulations. The Council's report has set in motion a much needed process to develop scientific consensus. Such consensus would lead to a better understanding of how the regulations should be cast and, if appropriate, how they should be modified. For example, the regulations could be revised to include informed scientific consensus judgement as the method for DOE proving it can meet the regulations concerning the repository.

As indicated above, it is important to realize that the Council's position statement is based on a conference that was held almost two years ago. Consequently, although the Council made a number of valid points, several of them have been appropriately addressed since they were made. The industry is currently evaluating the specific recommendations of the report, and will be pleased to offer detailed comments when this analysis is complete.

### CONCLUSION

It is important for society to dispose safely of its by-products. It is not appropriate to put off this task to future generations. The Federal Government has properly retained the responsibility for such disposal for high-level waste and spent fuel, and Congress has charged DOE with implementing disposal in a deep geologic repository.

For the nation to continue to enjoy the economic and environmental benefits of nuclear generated electricity into the next century, we must have timely and acceptable progress toward nuclear waste disposal. Therefore, this program must be seen as an opportunity to solve a national problem, not only for ourselves, but for future generations.

Access to Yucca Mountain is our most pressing concern with this program. DOE must be permitted to begin characterizing the site to determine its suitability. Congress may have to act again in this regard.

A timely, properly configured and licensed MRS, in operation by 1998, would provide needed evidence of DOE's progress toward an operational disposal system. It would also reduce the need for utilities to build additional on-site storage facilities, thereby saving money for electric ratepayers. Finally, a timely MRS would add a significant degree of flexibility to the overall waste management system.

I appreciate the opportunity to discuss this important matter with you today. I would be pleased to answer any questions you may have.

TESTIMONY BEFORE THE U.S. SENATE  
SUBCOMMITTEE ON NUCLEAR REGULATION OF THE  
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS  
OCTOBER 2, 1990

CHAIRMAN MICHAEL WILSON  
FLORIDA PUBLIC SERVICE COMMISSION



## Testimony

Chairman Michael Wilson

Florida Public Service Commission

Chairman Graham and distinguished Subcommittee Members:

Good morning, I am Michael Wilson. I am Chairman of the Florida Public Service Commission. I am also Chairman of the Subcommittee on Nuclear Issues-Waste Disposal of the National Association of Regulatory Utility Commissioners (NARUC), on whose behalf I appear today. The NARUC is a quasi-governmental, nonprofit organization founded in 1889, consisting of utility regulators from the 50 states, the District of Columbia, Puerto Rico, and the Virgin Islands. Our chief objective is to serve the public interest by seeking to improve the quality and effectiveness of government regulation in America.

The purpose of my appearance before you today is twofold:

1) to discuss where the Department of Energy's (DOE's) Civilian Radioactive Waste Management Program, commonly referred to as the Nuclear Waste Program (the Program), has been and where it must go from here; and 2) to answer the questions you have raised concerning the DOE's Yucca Mountain site characterization program, the sufficiency of cost

control and contractor accountability in the Program, the conclusion drawn in the report "Rethinking High-Level Radioactive Waste Disposal" prepared by the National Research Council of the National Academy of Sciences (the NAS Report) that the Program is "unlikely to succeed," and the recommendations made in the NAS Report.

#### Nuclear Waste Program to Date

Public utility commissioners have had two major concerns with the Nuclear Waste Program since its inception with the enactment of the Nuclear Waste Policy Act of 1982: finance and management. The first major concern we have is the amount of money already paid into the Nuclear Waste Fund by the ratepayers - not utilities - for the purpose of establishing a permanent storage repository for spent nuclear fuel. Through June 30, 1990, ratepayers in this country have provided \$6.9 billion to the DOE's Nuclear Waste Fund through a mandated fee of 1 mill per kilowatt-hour generated by nuclear units. Through June 30, 1990, the DOE has spent \$2.6 billion on the program and could spend \$30 to \$40 billion more in order to accomplish its charge to establish a permanent repository for the storage of spent nuclear fuel, or nuclear waste. The public utility commissioners of this country have a responsibility to the ratepayers of their states to insure that the program succeeds - that the enormous

amount of money already collected and spent by DOE, as well as all future funding of the Program, result in the successful completion of the repository.

The second major concern we have is the management of the program to date. From the beginning, the program has been plagued by frequent delays, which have, in turn, increased the costs of the program. For example, the commencement of drilling of a deep exploratory shaft was first scheduled for 1985, then for 1989, and, finally, for 1992. The most significant delay is that of the opening of the repository itself - initially scheduled to open in 1998, then 2003, and now 2010. Also indicative of the managerial problems the program has experienced is the fact that the program was without a director for two years before the appointment this year of Dr. John Bartlett.

Because of these continued concerns about the amount of ratepayer money involved and the serious delays in the program, the NARUC Subcommittee on Nuclear Issues-Waste Disposal, of which I am Chairman, passed a resolution in November 1989 creating the NARUC Nuclear Waste Program Assessment Office here in Washington. This office, which opened in July 1990, is being funded by states which have nuclear generation and is being staffed by Ron Callen, who is on loan from the staff of the Michigan Public Service Commission. It is important to note that these states were willing to commit funds at a time when all states

are facing budget restraints, as you are at the federal level. The opening of this office shows our commitment to insuring the fiscal soundness and managerial success of the Nuclear Waste Program and is an outgrowth of our active review of the Program and its difficulties. Our activities have included involvement with federal agencies, such as the DOE and the Nuclear Regulatory Commission, as well as testifying before this and other Congressional committees.

We are greatly encouraged by the actions taken by Energy Secretary James Watkins. In November 1989, he presented his "Report to Congress on Reassessment of the Civilian Radioactive Waste Management Program," in which he outlined a more realistic timetable for the permanent repository, a restructuring of the management of the program, and the development of an integrated Monitored Retrievable Storage (MRS) program for interim storage needs. Thus far, the DOE has worked steadily toward the goals Secretary Watkins set forth last year: Dr. Bartlett has been selected as Director of the Program and has begun its reorganization. Major changes, of which we approve, are the direct reporting relationship between the Nevada operation and OCRWM, and the appointment of David Leroy as Nuclear Waste Negotiator to facilitate the location of an MRS site.

### The Future of the Nuclear Waste Program

To be frank, the program must succeed, and it must begin to succeed now. While we are greatly encouraged by the DOE's actions in the past year and the willingness of the DOE to work with us, the program must make real progress now toward attaining both the ultimate goal of a permanent repository and the intermediate goal of an MRS program. The NRC has concluded that a number of reactor sites (67) will have reached spent fuel storage capacity limits by the year 2014, the approximate date that DOE is now projecting for the opening of a permanent repository. This makes meeting the Program's established goals critical.

In addition to the fees being collected from ratepayers for the permanent repository and, potentially, for an MRS site, ratepayers have also begun to pay for the construction of on-site storage facilities at nuclear reactor sites pending DOE acceptance of nuclear waste in 1998, the date mandated in the DOE's contracts with the nuclear generating utilities. Some of the electric utilities will simply not have enough storage capacity for spent fuel to wait until the DOE begins accepting waste; others might have enough storage until 1998, but cannot be assured that their fuel will be accepted quickly enough by DOE to avoid the need for additional on-site storage. In any event, wherever on-site storage facilities are built, the ratepayers will be paying for storage twice - once through the fee assessed



by the DOE for the Nuclear Waste Fund and again through inclusion in their utilities' rates.

Power plant license renewal for nuclear reactors, as proposed by the NRC, will only exacerbate the nuclear waste problem by extending the operating lives of nuclear reactors up to twenty years. And because of the environmental problems caused by other types of electric generation - coal, gas, and oil - regulators may, at some point, give serious consideration to additional nuclear power, either in the form of extending the life of current reactors or in the form of new nuclear plants. The problem of on-site storage and the potential for additional nuclear generation both amplify the need for success in the Nuclear Waste Program, as well as a reevaluation of the alternative of reprocessing nuclear fuel.

While it is our responsibility to insure that the fees are collected from the ratepayers and submitted to the Nuclear Waste Fund, we have no authority to review or oversee the Nuclear Waste Program itself. We suggest that you exert your oversight authority of the program to insure that there are no further delays and that the funds are spent prudently. We would like the DOE to be held accountable for each facet of the Nuclear Waste Program it budgets, so that funds are spent for their intended purpose.

### Your Questions Concerning the Nuclear Waste Program

In your letter of invitation, you raised four questions about the Program. The recent decision in the case of Nevada v. DOE before the U.S. Court of Appeals, 9th Circuit, is a first step in resolving the problem of access to the Yucca Mountain site. While not wanting to compromise the scientific integrity of the site characterization, we would urge that the investigation have reasonable and achievable goals, including a detailed model for performance assessment. Now that the Program has limited itself to characterizing a single geologic site, it is important to us and our ratepayers to determine as quickly as possible whether that site is suitable.

Although we are encouraged by Dr. Bartlett's efforts to reduce the number of contractors involved in the Program, we would like to see keen oversight and control of those functions of the program being performed by contractors. Studies by the General Accounting Office have presented past problems in this area in detail. Thus, your oversight is vital as Dr. Bartlett attempts to get the Program's timetable and costs under control.

Although we are regulators, not scientists, we are not yet ready to deem the Nuclear Waste Program as "unlikely to succeed." First, it must be kept in mind that the NAS Report is the result of a symposium held in 1988,

a full year before Energy Secretary Watkins presented his report to Congress on reassessing the Nuclear Waste Program. Second, we are concerned that, even at the most recent NAS symposium held last month, there is little emphasis on timely resolution of the licensing controversy among the Environmental Protection Agency (EPA), the NRC, and the DOE. While we acknowledge that the repository poses an interesting scientific problem, we are concerned that the problems be resolved, particularly the licensing problems, so that the Program may proceed. Third, the Program must succeed - the alternative is the storage of high-level nuclear waste at sites all over America, rather than at a single repository site. It is our hope that, when faced with the alternative and its attendant risks, the licensing agencies will resolve their problems with the single site repository so that it may be licensed. The NRC and the DOE are engaging in an on-going discussion on licensing requirements, performance analysis, and quality assurance. We urge you to inquire into the progress of these discussions to determine how far from resolution these issues are. While these discussions continue, the meter is running for the ratepayers at an annual level of funding of \$300 million for the DOE and \$20 million for the NRC.

Concerning the recommendation of the NAS Report other than the need to resolve the licensing problems, the Energy Secretary and NAS Report concur that the timetable of opening a repository in 2010 is more

realistic than the rigid, inflexible schedule embodied in the Nuclear Waste Policy Act of 1982 and its 1987 Amendments. Indeed, if the original overly-ambitious schedule had been achievable, I would not be here before you today. However, let me reiterate our concern that the deadlines that have now been set for the Program must be met at a reasonable cost.

We ask that, for the sake of the ratepayers who are funding this Program, you use your oversight authority to insure that the Program moves ahead.

We also concur that the DOE could benefit from international participation and review. Since many foreign programs for nuclear waste disposal appear to be fiscally sound and competently operated, the DOE could benefit from an interchange of information, particularly if such an interchange could keep the DOE from re-inventing the wheel in areas of its Program where other countries already have expertise.

Finally, we encouraged the consideration of alternatives to land-based geologic storage several years ago as being in the national interest. But now the DOE has no alternative to land-based deep geologic disposal and also no alternative to the Yucca Mountain site. Although the DOE Program has backed itself into the proverbial corner with regard to the storage site, we would urge the consideration of contingency planning, even if the Yucca Mountain site should prove successful.

Thank you for the opportunity to address you. If I, or NARUC, or our Washington office can be of any assistance to you in your consideration of this subject, please call on us. We are dedicated, as you are, to the success of the Nuclear Waste Program, but we would like the burden on our ratepayers to fund this Program to be reasonable.



STATEMENT OF  
JOHN W. BARTLETT, DIRECTOR  
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT  
BEFORE THE  
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS  
SUBCOMMITTEE ON NUCLEAR REGULATION  
UNITED STATES SENATE

OCTOBER 2, 1990

Mr. Chairman and Members of the Subcommittee:

I appreciate the opportunity to appear before you today to discuss the role and impacts of high-level radioactive waste disposal on the future of nuclear power. This is not only my first appearance before this Subcommittee, but is my first appearance before Congress since my confirmation in April as Director, Office of Civilian Radioactive Waste Management (OCRWM). I welcome the opportunity.

#### INTRODUCTION

Since this is the third in a series of three hearings which the Subcommittee has held on the future of nuclear power, I wish to reemphasize the Department's position on nuclear power and its importance in the National Energy Strategy. I would like to recap briefly where we are today with regard to the nuclear option. With this as the backdrop, I then will discuss management of high-level waste, one of the linchpins of a viable nuclear option, in terms of: (1) what the Department has done to implement the direction of the President and Congress; (2) what actions the Department will continue to take; and (3) what assistance Congress can provide.

Iraq's invasion of Kuwait and the resultant supply disruption has brought into sharp focus the need of the United States to lessen its dependence on Middle East oil. The U.S. energy requirements--notwithstanding our ability to apply energy conservation wisely and aggressively--will continue to grow.

Today, energy used for electrical generation accounts for approximately 36 percent of the primary energy consumption in the U.S. By 2010, we estimate that energy used for electricity will account for over 40 percent of total energy consumption. This increase in electrical generation amounts to over 200,000 megawatts of additional generation capacity that must be supplied.

Nuclear power is a key element of the Nation's energy base; it supplies about 20 percent of our electricity, our second largest source. As shown in Exhibit 1, without addition of new nuclear units and extension of existing nuclear plants, the contribution of nuclear energy will fall to zero by the year 2030.

One of our goals for the continued viability of nuclear power is to ensure our ability to package, transport and dispose of spent fuel and high-level radioactive waste in a timely, safe and environmentally acceptable manner. There is consensus that progress and confidence in proper management and ultimate disposal of high-level nuclear waste is one of the essential elements of the continued use of nuclear power as part of the Nation's energy resources.

#### BACKGROUND

This Nation must make some choices to sustain its economic productivity. Some choices have already been made with respect to the nuclear option.

First, in October 1981, President Reagan, in his first nuclear policy statement, recognized that the Federal Government had failed in meeting its responsibility to work with industry to develop an acceptable system for commercial waste disposal which further hampered nuclear power development.

He instructed the Secretary of Energy, working closely with industry and State governments, to proceed swiftly toward development of a means of storing and disposing of commercial high-level radioactive waste. He stated that the Nation must take steps now to accomplish this objective and demonstrate to the public that problems associated with management of nuclear waste can be resolved.

Secondly, in 1982, Congress followed by enacting the Nuclear Waste Policy Act, subsequently amended in 1987. That law established the U.S. policy for how and when the nuclear waste disposal system would be developed and demonstrated. And while the timeframes laid out in the law may be shorter than those of other Nations, the "how"--ultimate deep, geologic disposal--is the same internationally.

By taking the two actions described above, the President and Congress directed the Department to lead the Nation's effort to develop and operate a system for disposing of high-level nuclear waste in a manner that protects the health and safety of the public and the environment. Recognizing the importance of waste management to maintaining a reliable energy supply, the Department is taking aggressive actions to achieve progress and tangible results in developing a waste management and disposal system. In the nuclear waste management area, there is no consensus as to what constitutes clear solid evidence of progress and prognosis for success. In my view, to achieve success, a partnership between DOE and the Congress, with support from affected and interested parties, is essential.

Before I begin discussing the progress the Department has made toward developing a waste disposal system, let me say that there is one major obstacle that still confronts us--the refusal by the State of Nevada to grant

us the environmental permits that are required to allow us to get on site at Yucca Mountain and begin the much needed new scientific investigations. These new investigations are aimed at determining whether or not the Yucca Mountain site is suitable for development as a repository. Independent organizations responsible for program review and oversight, such as the Nuclear Regulatory Commission, Nuclear Waste Technical Review Board, and National Academy of Sciences are unanimous in their support for conducting the scientific studies at Yucca Mountain. While the recent decision of the Ninth Circuit Court of Appeals, upholding Congressional direction to investigate Yucca Mountain, certainly provides progress in moving forward to initiate such new scientific activities, we still must have these requested environmental permits to begin.

#### ACTIONS THE DEPARTMENT HAS TAKEN

In the early phases of the program the Department developed guidance and documentation, including siting guidelines, environmental assessments, and a mission plan, required for the program by Congress. The Amendments Act of 1987 directed the Department to concentrate its site characterization activities on a single candidate site at Yucca Mountain, Nevada. With this redirection, the Department issued a site characterization plan for Yucca Mountain, as required by the Act, and focused its efforts on determining the suitability of Yucca Mountain for development as a repository. This included developing the program plans for acquiring site-specific information on Yucca Mountain and using that information in complex performance assessments designed to evaluate the site's ability to contain and isolate high-level radioactive wastes.



A large part of the initial effort has been to develop the necessary "prototype" or "first of a kind" equipment, tools, processes, and procedures to be used in conducting scientific investigations at the site under the strict quality assurance program required for licensing and monitoring of long-term performance. As a single instance, dry drilling and coring operations have never before been conducted on the scale required at Yucca Mountain. They are required at Yucca Mountain both to allow accurate scientific interpretation and to preserve the integrity of the site and samples obtained from it. Preparation for these dry drilling and coring activities has required design, construction and testing of new equipment, as well as developing new operating techniques, and instituting precise new methods of handling and storing all samples acquired during drilling (Exhibit 2). In addition, the Department is implementing a program of environmental assessment and monitoring, for purposes of identifying and monitoring sensitive species and ecosystems, and providing a basis for mitigation should any adverse impacts occur during site activities. Similarly, the Department is conducting socioeconomic monitoring programs to provide a basis for mitigation of impacts, if needed. Development is also continuing on preliminary design concepts for engineered barrier systems, such as waste forms and containers, as well as on elements of the transportation systems, both highway and rail, that may be used in the handling and transportation of the high-level waste (Exhibit 3).

These examples are representative of the critical ongoing activities that are being conducted to ensure that we have all necessary systems in place to initiate site characterization activities, once we receive the necessary State permits, and to properly evaluate and utilize the information that will be

obtained through site investigation. Through actions such as these, we believe that we can ensure progress toward meeting the programmatic objectives identified by Congress.

After Secretary Watkins came on board in spring 1989, he initiated a review of the Civilian Radioactive Waste Management Program. In addition, the 1990 Appropriations Act directed the Department to submit a report to Congress within 60 days of enactment to describe in detail how the Secretary intends to deal with schedule slips, problems in management structure, and lack of integrated contractor efforts. This "60-Day Report" was issued in November 1989, and announced initiation of a three-point action plan to achieve targeted goals and milestones. The three points of this action plan include:

- o Implementing improvements in the management of the program.
- o Gaining access to the Yucca Mountain site, focusing initial scientific investigations on potential disqualifying factors, and, should the site prove acceptable, developing the repository on a realistic schedule, with waste acceptance starting in 2010.
- o Developing a Monitored Retrievable Storage (MRS) facility with waste acceptance starting in 1998.

Since my confirmation in April, I have taken a number of steps to assure that these three objectives can be met. In addition, I have taken action to assure that the management and technical activities of the program foster clear, identifiable progress.

With these goals in mind, I have promoted an attitude of aggressive resolve to accomplish the program's mission as set forth in the Nuclear Waste Policy Act, as amended.

As one of my first actions, I thoroughly assessed our existing management and organizational structure for developing the Nation's high-level nuclear waste system. Following this assessment, I announced initiatives to improve the management of this program. As part of these initiatives, I have developed and issued a Management Systems Improvement Strategy to outline the approach I intend to implement in achieving the permanent disposal of high-level waste. This strategy recognizes that an integrated set of physical, programmatic and management functions must be identified, integrated and performed in order to successfully bring the waste management system into being. The strategy identifies the process to be followed in analyzing and designing the waste management system and has been carefully integrated with the structure of my proposed reorganization.

As a result of this assessment, I postponed the quality assurance (QA) audits of the DOE Headquarters and Project Office programs that were to have been performed last June and July. My review indicated that improvement was needed in the content and integration of program documents and their use in compliance with the Department's QA system, and I wanted to make sure we were ready for such an audit. It is both noteworthy and a significant accomplishment that seven of the major participants in the Yucca Mountain Project (three National Laboratories, the U.S. Geological Survey, two architect/engineers and the construction contractor--representing 1,000 scientists, engineers, and support personnel) have passed their qualification audits. The upcoming audits of the DOE offices are extremely important to our initiation of new field work at Yucca Mountain, once we are granted State

environmental permits.\* I believe we have made significant progress toward meeting our goals, and I have rescheduled these audits for later this month (October).

Also as part of my initiatives to improve management, and very closely tied with the Management Systems Improvement Strategy, I have announced a proposed reorganization, which moves away from the matrix structure which has existed over the past 2-1/2 years. It is designed to provide clear lines of responsibility, authority and accountability for the Civilian Radioactive Waste Management Program and its contractors. The proposed reorganization has been incorporated into the Management Systems Improvement Strategy.

I have also evaluated schedules contained in the Near-Term Decision Plan initially issued by the Secretary last November, and revised near-term technical program strategies and plans to achieve key milestones along the long-range path. To assure success in maintaining these new strategies and milestones, I have begun development of new management control systems that increase accountability and effectiveness of operation.

Finally, we are continuing to maintain and expand dialogue with affected and interested parties. With regard to Nevada, the Secretary and I have had discussions with numerous State leaders in an effort to establish a cooperative working relationship for progress in evaluating the suitability of the Yucca Mountain site as a location for a high-level waste repository.

\*In order for us to begin new studies early next year of the geologic structure in the Midway Valley and the new calcite silica studies in Trench 14, I am committed to having in place both the participant and DOE QA programs.

In addition, we will be conducting workshops in which we will have external parties participate in developing the basis for DOE decisions on focusing future program activities.

#### ACTIONS THE DEPARTMENT WILL TAKE

These previous items represent major actions that the Department has already taken to advance development of the high-level nuclear waste disposal system. In the future, we will continue to maintain and act on our posture of aggressive resolve to fulfill the OCRWM mission.

We will continue to develop the tools, equipment, processes and procedures needed to conduct scientific investigations at Yucca Mountain and to analyze data acquired through these investigations (Exhibit 4, 5).

We will continue to collect and analyze data from laboratory activities as well as from ongoing field activities. We will continue to develop models of natural barriers, develop our performance assessment capabilities, and proceed with conceptual engineering designs. In addition, we will continue to prioritize the plans for these scientific activities and focus near-term efforts on those investigations that examine potential unsuitable conditions at Yucca Mountain.

We will continue key activities supporting transportation of high-level waste, including development of cask systems, transportation support systems, and institutional interactions.

We will also continue key efforts supporting the development of the Monitored Retrievable Storage facility, such as design and engineering studies, including initiation and completion of the conceptual design;



environmental, regulatory and licensing activities; and feasibility grants to States, Tribes and local entities, as authorized in the Amendments Act (Exhibit 6).

We will provide any support requested by Mr. David Leroy, the newly-confirmed independent Nuclear Waste Negotiator, as he initiates his efforts to identify volunteer sites both for a MRS facility and for alternate repository sites.

We will work to broaden our ongoing interactions with external groups such as the Nuclear Waste Technical Review Board, the National Academy of Sciences, and the Secretary's Energy Advisory Board and extend their use as sounding boards and for independent expert review and assessment of the Department's technical program. These independent program reviews provide important contributions to the Department's efforts to resolve the Nation's waste disposal issues as witnessed by the recent National Research Council's Board on Radioactive Waste Management report "Rethinking High-Level Radioactive Waste Disposal." The report offered many insightful and creative recommendations to improve the waste management program, many of which are in complete accord with initiatives already undertaken by Admiral Watkins in his recent restructure of the OCRWM program. A comprehensive review of the report's findings is currently underway, and when fully evaluated, will be discussed with the Council, Congress and other interested parties.

Building on our current efforts to increase the involvement of external parties in predecisional planning, we will expand the avenues, frequency and substance of dialogue with affected and interested parties. In this vein, and in keeping with the Secretary's strong commitment to expanding Departmental initiatives to increase scientific literacy in the country, we will continue

and broaden our information and education efforts. These will include maintaining our OCRMM graduate fellowship program, participating in international workshops sponsored by the Nuclear Energy Agency of the Organization for Economic Cooperation and Development (OECD/NEA), designing teaching curricula to be used throughout the member nations of the OECD/NEA, and continuing our programs to provide information on high-level waste disposal to the public to facilitate communication.

Through initiatives such as these just mentioned, I believe we can continue to build on the foundation we have established and show progress in our resolve to move forward aggressively to achieve our goals.

#### ASSISTANCE CONGRESS CAN PROVIDE

Congress can greatly assist us in our efforts and increase the probability of our progress and success by taking some positive actions.

These include assuring that we have sufficient resources in terms of both dollars and people to maintain the Secretary's plans and schedule of critical milestones. We suggest that Congress might even consider the approach, used by the Canadian government and other U.S. programs, of issuing multi-year funding.

I believe that Congress needs to be fully aware of the actions taken by the State of Nevada to thwart the will of Congress and to create the impasse which currently exists between the Department and the State regarding access to the Yucca Mountain Site. These actions seriously affect our ability to make progress in achieving the Nation's goal of safe disposal of high-level waste and continuing the viability of the nuclear energy option. There are a

number of serious legal issues existing between the Department and the State of Nevada which must be resolved before the Department can proceed to fulfill its obligation under the law to evaluate the Yucca Mountain site. To date, we have been unable to gain access to Yucca Mountain to initiate new scientific investigations. In 1989, Nevada enacted legislation declaring storage of high-level radioactive waste to be unlawful in Nevada. The Nevada State Attorney General then issued an opinion that all the Department's environmental permit applications were moot. In early 1990, Nevada filed a lawsuit challenging the Department's failure to terminate site characterization. The Department has filed a complaint seeking injunctive relief to require Nevada to process the permit applications. Nevada has also filed other legal challenges against activities at the Yucca Mountain candidate repository site. Oral arguments on the first case were heard August 16, and on September 19, 1990, the Ninth Circuit Court of Appeals rendered a decision in favor of DOE, holding that Congressional direction to the Department to investigate the suitability of Yucca Mountain as a potential site for a nuclear waste repository overrides all State objections. DOE will now press forward with the permit application suit filed in U.S. District Court in Las Vegas. Our ability to initiate new scientific investigations early next year as currently scheduled is seriously jeopardized by the current impasse, as are our overall efforts to meet longer-term milestones and the goal of beginning repository operations in 2010.

The Monitored Retrievable Storage facility plays a crucial role in the Department's strategy for accepting waste in 1998. We hope that through the efforts of the Nuclear Waste Negotiator, a volunteer host State for the MRS facility will be found, and a benefits package negotiated. According to the

requirements of the Nuclear Waste Policy Amendments Act of 1987, this benefits package must be approved by Congress. This approval process could provide an appropriate opportunity for Congress to consider legislation to modify the close coupling of the development of an MRS facility to authorization of repository construction. At present, this close coupling limits the Department's ability to proceed with development of the MRS and casts uncertainty on the Department's ability to meet the 1998 goal for waste acceptance. In addition, Congress could encourage States to seriously consider opportunities to host the MRS facility, recognizing that, in addition to the facility itself, a package of activities and functions with significant socioeconomic benefits can be negotiated through the efforts of the Nuclear Waste Negotiator.

Finally, Congress can help promote and provide a sense of Federal resolve and national stewardship on the part of all parties involved in this process.

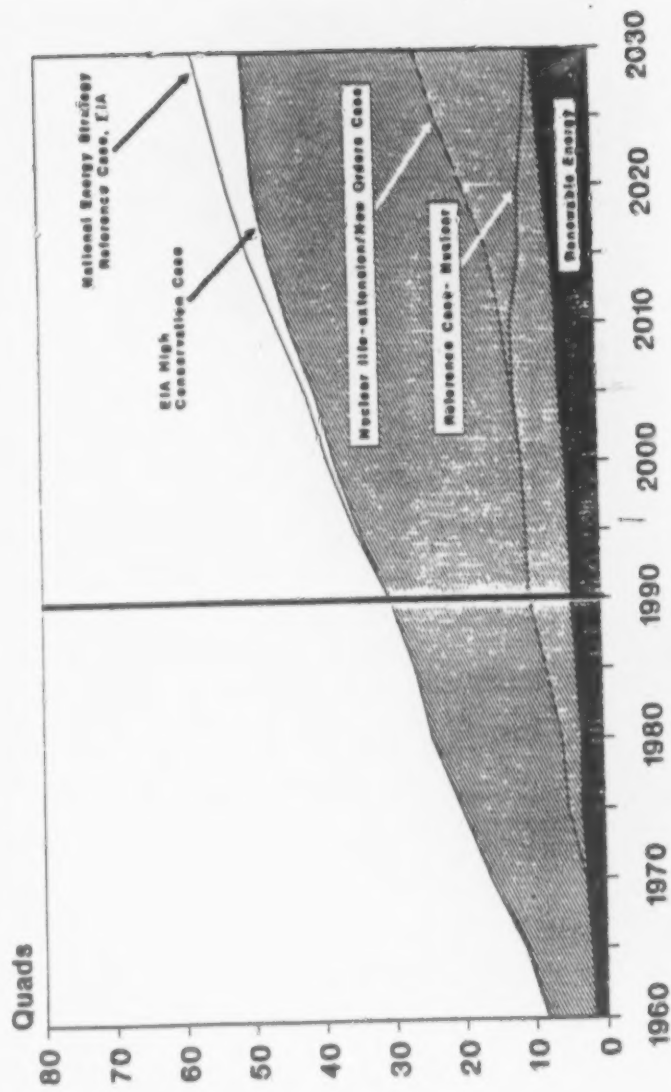
#### CONCLUSION

I strongly believe that the combination of these actions described above will quickly bring positive results in our efforts to move forward to solve the national dilemma of permanent disposal of high level-waste, and will allow us to remove one of the most obvious obstacles to the continued use of nuclear energy to maintain reliability in our national energy resources.

Thank you for the opportunity to appear here today to discuss these issues with you. We have addressed the specific issues mentioned in the Subcommittee's letter of invitation to this hearing, and the responses are provided in the attachment.

# Exhibit 1

## Projected Consumption of Primary Energy for Generation 1990 - 2010



Source: National Energy Strategy Reference and High Conservation Cases, EIA, National Energy Strategy Information White Paper for Renewable Energy



178

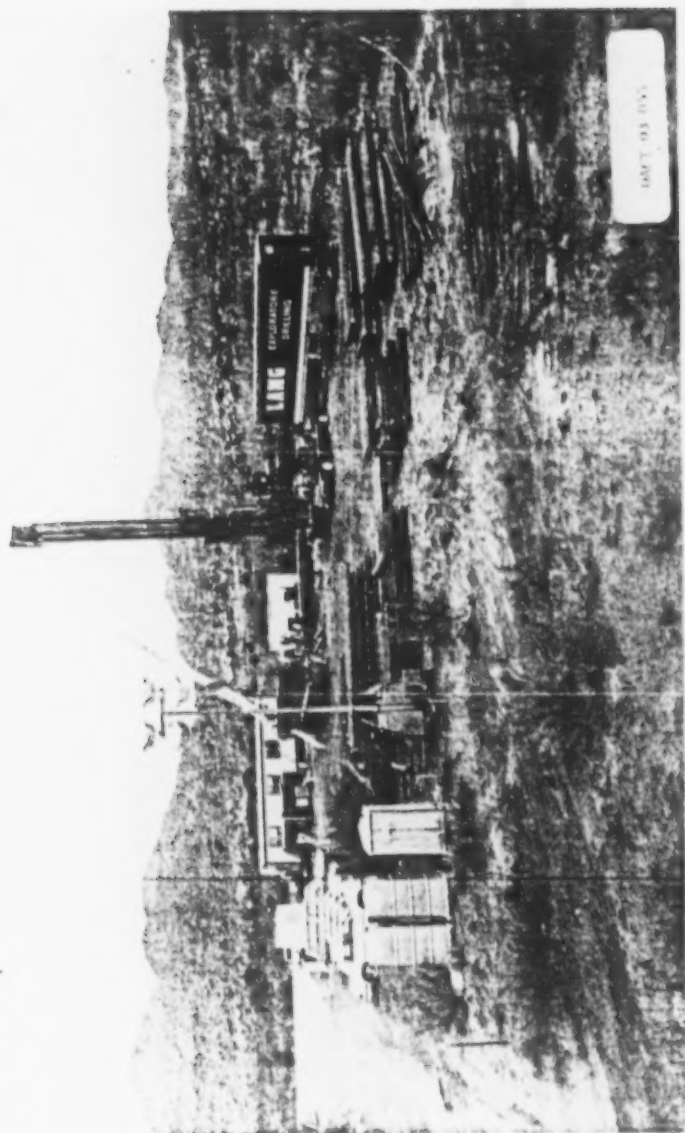


Exhibit 3

# REPRESENTATION OF KEY TRANSPORTATION ACTIVITIES IN FY91 (\$000)

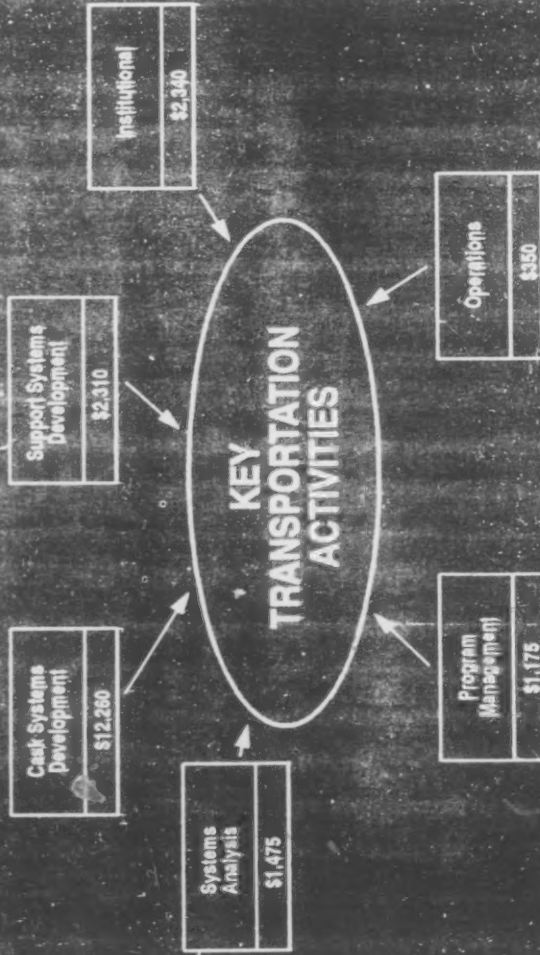
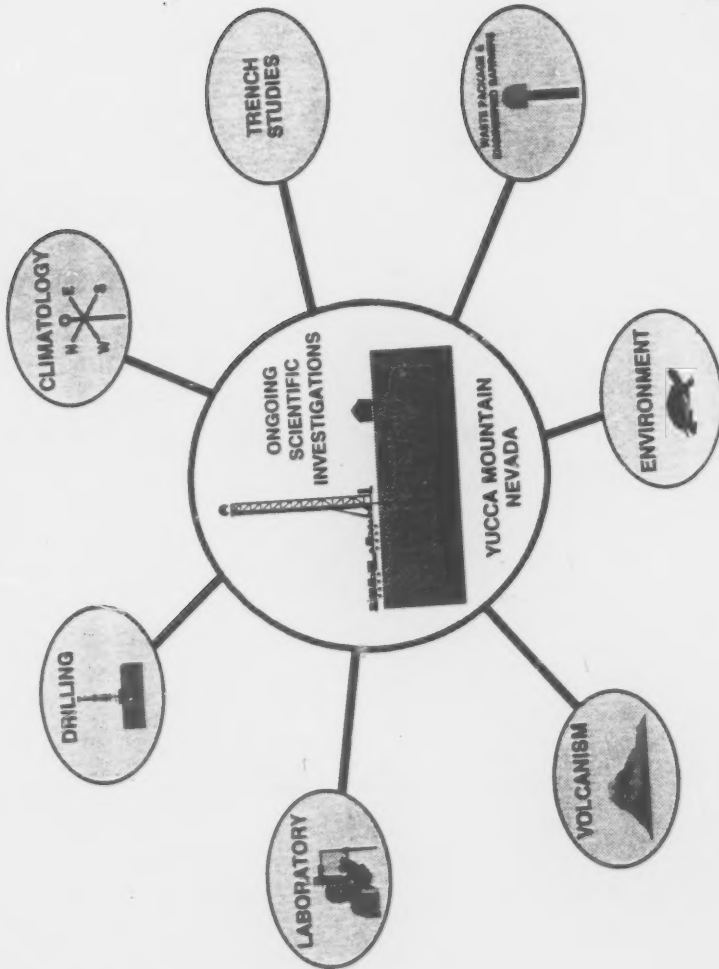


Exhibit 4



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# Exhibit 5

## REPRESENTATION OF KEY SCIENTIFIC INVESTIGATION ACTIVITIES FY91 (\$000)

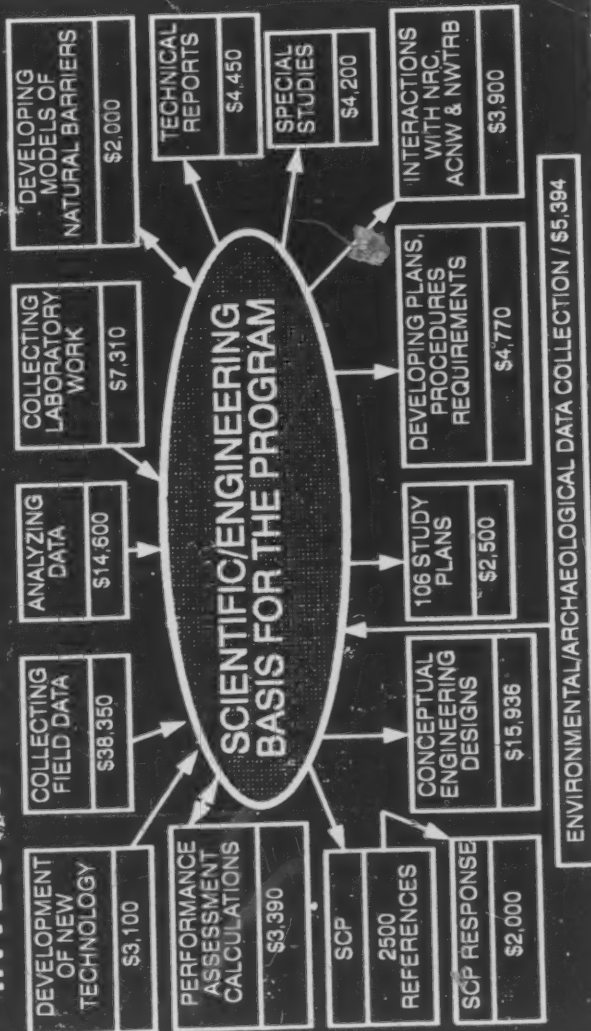


Exhibit 6

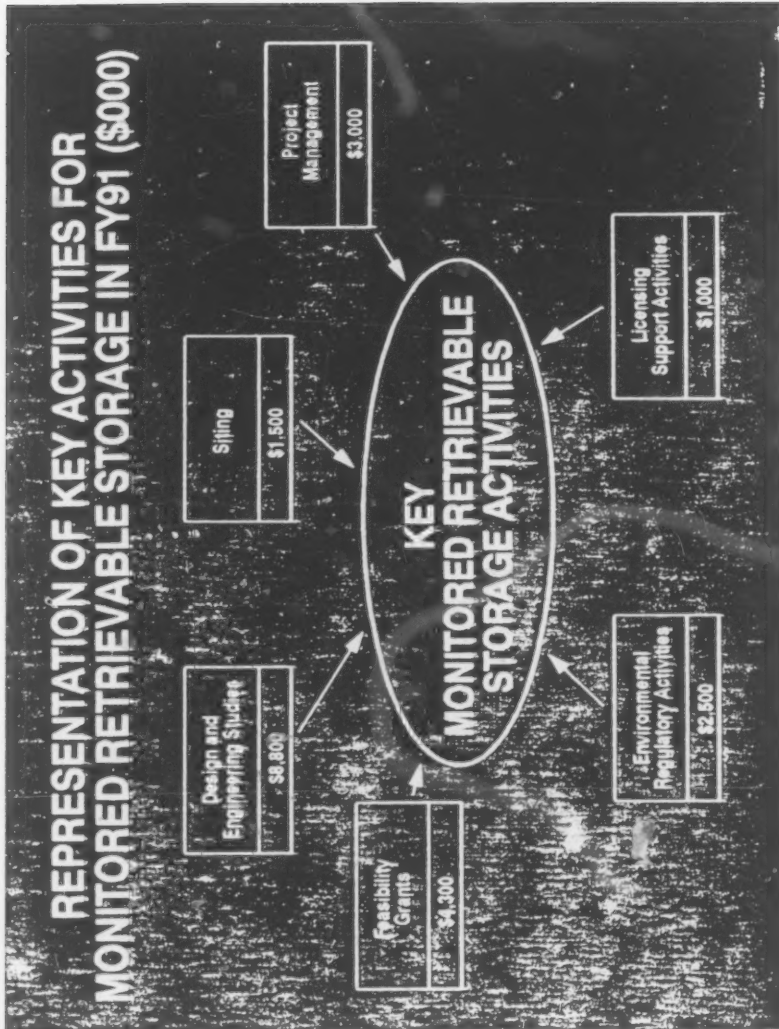
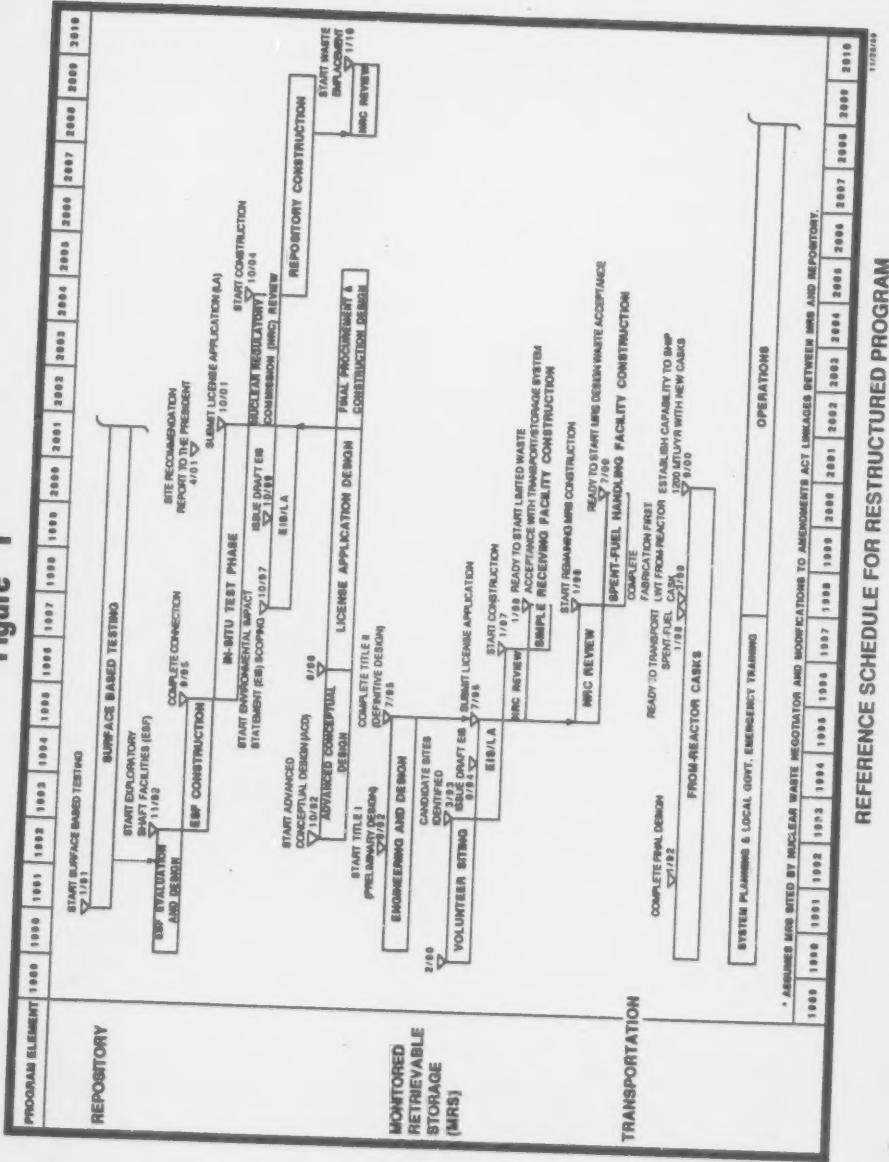




Figure 1



## QUESTIONS FROM SENATORS SIMPSON AND GRAHAM

QUESTION 1: What steps is the DOE taking to commence site characterization?

ANSWER: The DOE is eager to begin new studies at Yucca Mountain in light of the decision by the Ninth Circuit Court of Appeals in DOE's favor in the suit brought by the State of Nevada. The State had claimed the right to prohibit DOE from carrying out the Congressional mandate under the Nuclear Waste Policy Amendments Act of 1987 because the State Legislature had "disapproved" the Yucca Mountain site.

A three-judge panel of the court issued a unanimous 41-page decision on September 19, 1990, that addressed all the issues raised by Nevada. The court ruled in favor of DOE on each and every issue (both constitutional and statutory) holding that Nevada's attempted legislative veto of the Secretary's site characterization activities is preempted by the Amendments Act.

In preparation for the start of new, surface-disturbing site characterization activities at Yucca Mountain, the DOE is concentrating on several areas. DOE's highest priority at the moment is preparing for the upcoming quality assurance qualification audit for OCRWM Headquarters and the Yucca Mountain Project office, which will take place in October. It should be noted that, at the present time, those project participants actually responsible for performing these site characterization activities

are fully qualified to perform the work under quality assurance programs that have been accepted by the Nuclear Regulatory Commission (NRC).

Numerous study plans describing the activities to be performed during site characterization are in preparation. Twelve of these plans have already been provided to the NRC for its information and comment. Four study plans have been considered, resulting in no objections by NRC staff. Eight study plans are in the process of NRC consideration. When permits are issued by the State of Nevada, the DOE will be fully prepared to start these activities.

Based on the Court of Appeals ruling, DOE intends to press forward with the suit against the State of Nevada that was filed by the Department of Justice last January in U.S. District Court in Las Vegas, Nevada. That suit contends that Nevada has prevented DOE from carrying out necessary site investigation work by unlawfully refusing to act on permit applications.

## QUESTIONS FROM SENATORS SIMPSON AND GRAHAM

**QUESTION 2:** What degree of confidence does DOE have that it will be possible to demonstrate compliance with the EPA probabilistic standards in a licensing proceeding for Yucca Mountain?

**ANSWER:** DOE comments on Working Draft 2 of 40 CFR 191 were submitted to the Environmental Protection Agency (EPA) on August 2, 1990. The comments provided DOE's current position on the Working Draft EPA standard. DOE indicated that it was "...concerned with the implementability of the containment standards, as they are being interpreted, because of their quantitative, probabilistic nature and the stringency of the numerical release limits." DOE has commented specifically on Section 191.13 -- Containment Requirements: "The DOE is concerned with the implementability of the containments requirements as they are being interpreted. A literal interpretation of the requirements would preclude the use of qualitative judgment by the implementing agency as intended by EPA. Without a significant measure of qualitative judgment allowed by the rule, the combination of the quantitative, probabilistic nature of the standard and the stringency of the numerical limits for allowable releases would make it difficult to demonstrate compliance at any site."

Several other organizations have raised concerns regarding the EPA standard. The Advisory Committee for Nuclear Waste has stated "There are no obvious ways for demonstrating compliance of any specific

repository site with the Standards. In this sense, the Standards may be unrealistic;" and, "The Standards are also overly stringent and inconsistent. There is strong evidence that they will be wasteful of resources with little commensurate benefit." The Nuclear Waste Technical Review Board (NWTRB), in its report to the Congress and the Secretary of Energy of March 22, 1990, has stated "in Section 191.13, Containment Requirements, the release limits discussed in this Section (and contained in Table 1 of Appendix B, Section 191.13) appear very conservative and inconsistent with present day regulatory practice and scientific consensus. An example relates to  $^{14}\text{C}$ , which is routinely released by nuclear power plants and fuel reprocessing plants, was released in atmospheric weapons tests, and is generated continuously and naturally by cosmogenic means in the atmosphere. The annual doses predicted for  $^{14}\text{C}$  release from the high-level nuclear waste repository are very small fractions of those currently being received from the  $^{14}\text{C}$  produced from previous nuclear weapons tests and even smaller when compared to doses from naturally produced  $^{14}\text{C}$ ." The NWTRB has recommended "The large degree of conservatism, which is expressed in Section 191.13, and contained in the numerical values in Table 1, Appendix B of that Section, should be re-evaluated in view of present-day environmental and regulatory requirements and also, when appropriate, in view of exposures received routinely and continuously from naturally occurring radiation."

QUESTION 3: What are DOE's views on the conclusion of the National Research Council of the National Academy of Sciences that "the U.S. program, as conceived and implemented over the past decade, is unlikely to succeed?"

ANSWER: The National Research Council's position statement is based largely on an assessment of the high-level radioactive waste management program as it was two years ago. Significant changes in the program were initiated last fall by the Secretary, as reflected in the November 1989 "Report to Congress on Reassessment of the Civilian Radioactive Waste Management Program." These and other initiatives are being implemented by the program with the full support of the Secretary. The current approach being taken by the Department is not, therefore, the approach actually assessed by the National Research Council. Although the program faces many challenges, the Department does not believe that the approach currently being taken is unlikely to succeed.

At the same time, one of the bases for the National Research Council's statement that success is unlikely appears to be that the current program is not sufficiently flexible or exploratory to accommodate changes that will be required by the inherent variability of the geological environment. The Department shares the view that the development of a geologic repository may benefit from an approach that is more exploratory in nature than has been contemplated in the past. We plan to initiate



discussions with a variety of affected and interested parties later this year on this matter and on other subjects of strategic importance to the program.

QUESTION 4: More specifically, what are DOE's views on each of the recommendations of the report (pages 31 and 32 of the report)?

ANSWER: Admiral Watkins has directed the Office of Civilian Radioactive Waste Management to conduct a comprehensive review of the National Research Council's findings. As is evident, the findings and recommendations address fundamental aspects of the Nation's high-level radioactive waste management program, including standards and regulations established by the Environmental Protection Agency and the Nuclear Regulatory Commission. Careful consideration of the findings and recommendations is obviously required. Bearing this in mind, the Department has advised the National Research Council that the initial results of its review should be available for discussion by November 1, 1990. We would be happy to discuss these initial results with Congress at that time.

QUESTION 5: What procedures has DOE established and implemented to ensure that program costs are controlled and that program contractors are accountable for their performance?

ANSWER: OCRWM has implemented the DOE project management system policies contained in DOE Order 4700.1 through the program-specific requirements described in the OCRWM Program Management System Manual. In August 1990, the Secretary strengthened the DOE project management system by improving senior management involvement in the early identification of potential cost overruns or schedule slips at the project and contractor levels and the implementation of corrective action plans. On August 15, 1990, the Deputy Secretary of Energy sent the Senate Subcommittee on Nuclear Regulation a letter describing this improved project management system.

OCRWM is in the process of revising its program-specific requirements and related project control documentation to incorporate the revised DOE project management system requirements. In addition, OCRWM has formally proposed restructuring its current organization to provide clearer lines of responsibility, authority, and accountability for the program and its contractors.

OCRWM's Program Management System has the following key features:

- o A hierarchy of technical, cost, and schedule baselines at the program, project, and contractor levels.
- o A hierarchy of change control boards at the program, project, and contractor levels that control changes to these technical, cost, and schedule baselines.
- o A Yucca Mountain Project Planning and Control System (PACS) to integrate technical scope, cost, and schedule. Work performance is measured monthly and variances from planned work are reported. Contractors and other participants responsible for a cost and/or schedule variance that exceeds predetermined thresholds must submit a variance analysis. This analysis includes the cause and impact of the variance plus proposed corrective action to minimize the cost overrun or schedule slip. A briefing on this Yucca Mountain PACS was given to the Senate Subcommittee on Nuclear Regulation staff by OCRWM management on September 20, 1990.

- o Contractor compliance with the DOE cost and schedule control system criteria for contractor performance measurement.

In addition, OCRWM is subject to the following controls by the Department's Acquisition Executive:

- o Approval of technical, cost and schedule baseline changes that exceed predetermined thresholds.
- o Readiness reviews at key decision points prior to the release of funds.

**ISSUES IN EVALUATING SUITABILITY  
OF THE CANDIDATE REPOSITORY SITE**

**John W. Bartlett, Director  
Office of Civilian Radioactive  
Waste Management  
U.S. Department of Energy**

**Presented to**

**SPECTRUM 90  
Nuclear and Hazardous Waste Management  
International Topical Meeting  
October 1, 1990  
Knoxville, Tennessee**

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**October 1, 1990**



ISSUES IN EVALUATING SUITABILITY OF  
THE CANDIDATE REPOSITORY SITE

INTRODUCTION

Those of you who have followed the U.S. high-level radioactive waste program are familiar with the difficulties of the past and the tough challenges of the future. With the total support of Admiral Watkins, I have taken several initiatives to streamline and strengthen program management. These include developing a strategy for carrying out the U.S. program for disposal of spent fuel and high-level radioactive waste as mandated by Congress in the Nuclear Waste Policy Act; establishing a national consensus on that strategy; developing effective working relationships with parties who have a stake in the program; ensuring that methods and criteria for demonstrating compliance with regulatory requirements are developed and ready when needed; focusing actions on goals and essential activities; and improving cost effectiveness and accountability.

To effectively implement these concepts which Secretary Watkins and I believe are fundamental to success, two significant changes are underway. First, we have put into place a new organization which focuses our resources on the mission assigned to us by Congress and provides all essential support functions.

Second, we have developed and are implementing a Management Systems Improvement Strategy (MSIS). This strategy recognizes that, just as the system and its elements are designed

to perform their functions, so can the program be designed to accommodate its unique characteristics and to accomplish the overall mission. We have begun a number of activities to implement that strategy, including a rigorous analysis of both physical-system and programmatic functions. And we are putting in place an appropriate quality-assurance program.

#### THE IMMEDIATE CHALLENGE

With these program improvement actions as our basis, we are beginning to address our challenges for the future. One important challenge in the near future is the suite of actions required to prepare for and to conduct evaluations of the suitability of the candidate site as a repository location. These actions will involve development of strategy, plans, and readiness for the conduct of the data acquisition program; acquisition and technical interpretation of the data; and use of the data in a system of analytical methods and criteria to make findings concerning site suitability. My talk today will focus on the issues associated with site suitability evaluation.

Progress in these actions depends in part, of course, on access to the Yucca Mountain site in order to expand our data acquisition capabilities. As I'm sure you know, we are in court with the State of Nevada in regard to our right to conduct the site evaluation. I'm sure you also know that the Ninth Circuit Court of Appeals recently ruled that Nevada's allegations that DOE has no right to proceed with evaluation of the Yucca Mountain site have no merit. While this victory for the Department is highly important, it is but a first step toward site access. The State apparently plans to appeal the decision, and we still have to have the permits needed to resume surface-disturbing activities. Meanwhile, we will be ready to resume activities in January of 1991, and will do so if everything falls into place.

Before proceeding further, I want to distinguish between "suitability" and "licensability", and how they relate to the issues surrounding the evaluation and selection of a site for development as a repository. The decision on the suitability of a site for recommendation to the President for development as a repository is the responsibility of the DOE under the provisions of the Nuclear Waste Policy Act, as amended. The decision on the licensability of a recommended site, once approved by the President and Congress, belongs to the Nuclear Regulatory Commission. The repository siting guidelines developed in 1984 in response to the Act reflect this distinction. The guidelines also reflect the fact that the decision on site suitability must take into account environmental standards promulgated by the Environmental Protection Agency and those safety criteria that will be used by the NRC in their licensing reviews. Thus, it is obvious that there is no benefit to declaring a site to be suitable if it cannot meet these independently developed Federal safety and environmental requirements for licensability. In other words, the evaluation of suitability must keep licensability in mind.

Since site-evaluation will be a major research and evaluation investment, we are developing an approach to using the data collected in this program in a manner consistent with the prudent management of resources. For example, near-term data acquisition activities will focus on disqualifying factors in the regulations, and thus avoid extended investment of time and resources if a valid reason is found to believe that a repository developed at the site would not be likely to meet licensing and regulatory requirements. These initial evaluations will draw on information already developed in the mandated site characterization plan (SCP) for defining the scope of the site-evaluation program.

In addition to evaluating current site conditions in terms of suitability, the site-evaluation program must also address the processes and events that might occur in the future and might affect those characteristics of the site that are important to waste isolation. The processes and events to be investigated are those that appear to be sufficiently credible, on the basis of available data, to warrant consideration. For example, we will investigate the possibilities for extreme climate changes or faulting to produce effects on the percolation of water, the local flux, and the elevation of the water table in relation to the repository horizon. The probability and the potential effects of volcanic and other igneous activity on the characteristics of the site will also be investigated.

We are developing an approach which will enable us to proceed iteratively with site evaluation. I am assigning a great deal of importance to the development of this approach. In general, the approach has two basic components: the collection and scientific interpretation of data, and evaluation of the data using regulatory and program decision criteria. The process might include, for example, specifications of probability distributions or ranges of parameters that define suitability measures for the site, sampling these distributions to produce distributions of the suitability measures, the use of experimental techniques to determine the probability that the tests being conducted will detect the features associated with these suitability measures, and then comparing the results of the tests to make comparisons against the criteria. Such techniques have been successfully applied to analyses of sites in Switzerland.

The necessary data will be collected through the activities planned for site evaluation. These activities consist of surface-based studies (which will be the initial focus of the DOE's site characterization program and include drilling, laboratory tests, and modeling), and

underground tests and studies to be conducted in an exploratory facility constructed at the depth of the proposed repository. The exploratory facility will be constructed to provide access to the proposed repository horizon in order to conduct in situ tests needed to evaluate the hydrologic, geochemical, geomechanical, and thermal conditions that would be expected in a repository if built at the candidate site, and to evaluate the host rock at the depth proposed for waste emplacement.

The evaluation program will focus first on features of the site that can be investigated through surface-based testing. The objective is to obtain early information about the site conditions or features that have the potential to so adversely affect performance that the site may not be able to meet the regulatory requirements and would therefore be disqualified.

The near-term focus on surface-based testing relative to evidence of unsuitability is not meant to suggest that underground testing is deemed less important. Although certain surface-based tests may yield information about conditions that are potentially adverse and indicators of unsuitability, they are unlikely to be sufficient by themselves to support the eventual evaluation of whether the site is suitable.

The iterative process will not produce definitive findings in the early stages of evaluation unless the site is found clearly to be disqualified. It will, however, allow us to take maximum advantage of information from early testing, including the ability to make early adjustments in our testing and design programs. If investigations uncover conditions that would make the site unsuitable or licensing extremely difficult, this option might lead to an earlier decision as to the prudence of investing more time and money in the site. In addition, iterative evaluation of

suitability will provide a mechanism for keeping affected and interested parties apprised of developments in the scientific investigations.

One of the major challenges of the site suitability evaluation will be the application of the siting guidelines identified in Title 10, Code of Federal Regulations, Part 960 (10 CFR 960).

Possible approaches to application of the guidelines include:

- Focus on evaluating performance of the geologic and engineered components of the regulatory system. Criteria might be developed from consideration of regulatory safety performance requirements.
- Focus on the potential for future site dynamic behavior, such as earthquakes or saturation as a result of climate change, to perturb the repository. For example, limits on perturbation that will be permitted could be established.
- Focus on limits to our ability to reduce residual uncertainty in site characteristics. Because of the diversity of geologic characteristics of the site, the investments of time, money, and effort to investigate the site sufficiently to have low enough uncertainty about site characteristics may be excessive. Limits on investment of characterization effort may be necessary criteria.

The decision process to be utilized in determining whether or not the site is suitable also depends to a considerable degree on the stage of the evaluation process. In the early stages, disqualification criteria will be emphasized. If the site is found not to be disqualified,



criteria based on favorable and potentially adverse conditions, with focus on nuclide release, or dynamic behavior, or residual uncertainty will be used.

In interpreting and applying the siting guidelines it will be necessary to consider the interrelationships among the features and conditions that comprise the natural systems at the site. For example, the time it would take radionuclides to travel from a repository to the accessible environment, once they were released from a waste package, depends on (1) the length of the path traveled; (2) the retardation of the radionuclides, which depends, in a complex way, on the physical and chemical properties of the geologic environment; and (3) the velocity of ground-water flow, which in turn depends on the hydraulic conductivity, the hydraulic gradient, and porosity. In a host rock with a low retardation potential, a long path or a low velocity can provide the required long travel times; in a host rock with a more rapid flow, a long path or a high retardation potential can also provide the necessary confidence. No single numerical value for any of these site features is either necessary or sufficient to ensure that the system will perform satisfactorily; for such determinations, the three factors must be considered in combination. For the Yucca Mountain site, the potential for volcanism, seismicity, human intrusion, and climate change to alter site conditions in the future must also be considered.

Another issue in site suitability evaluation is development and use of what I call the "engine of evolution" of the iterative process. This engine will be basically performance assessment methodology adapted to the purposes of site suitability evaluation. Adaptation is necessary because performance assessment models include consideration of engineered barrier system performance, while site suitability evaluation must focus on geologic barrier performance. The methodology for site suitability evaluation must appropriately separate repository

performance and site performance, and must also include management criteria such as concern for our ability to reduce residual uncertainty sufficiently so that the determinations of whether or not the site is suitable can be made definitively.

Our programmatic strategy for site suitability evaluation has two basic elements. First, we are using multiple, independent approaches to development of the methodology. One approach is the DOE in-house effort. In parallel, two other independent efforts are being led by the Electric Power Research Institute and by Golder Associates. Each of these three efforts draws on the existing site data base as necessary, but the development of methodology is proceeding independently.

The second element of the strategy will be to compare and evaluate the approaches developed by the three independent efforts. This comparison will take place in an external technical forum such as might be provided by the Nuclear Waste Technical Review Board. Through use of such a forum we will make the candidate approaches available for external review and evaluation. The findings and recommendations stemming from these reviews will then be used by DOE in selecting and applying the site suitability evaluation approach to be used.

Through use of this strategy we expect to accomplish two things. First, we will assure that alternative approaches to site suitability evaluation are considered. Second, we will preserve the right and opportunity for other competent parties, such as the State of Nevada, to make independent contributions to development of the evaluation through participation in the technical forums. By this means we will assure that DOE does not unilaterally make up the

rules as it goes along. I would emphasize, however, that DOE has responsibility and authority for the site suitability decision. Our approach is designed to provide accountability for how we exercise that responsibility and authority.

### CONCLUSIONS

Evaluation of site suitability poses both a scientific and a management challenge of the highest importance and priority. We must bring together data on site characteristics, methods for evaluation, and criteria for evaluation. In all of our work, we must be mindful of the close relationship between suitability and licensability. Because of the importance of the site suitability evaluation, the DOE program must and will be based on input from multiple independent efforts. Data collection and analysis will be performed with the appropriate participation of affected parties, and decision criteria and application methods will also be developed through a process in which input is sought from external parties.

I look forward to a stimulating exchange of scientific information as we integrate the entire effort. This collective effort, I am convinced, will result in findings that are scientifically, analytically, and systematically sound. The Department of Energy must retain its mandated responsibility for determining whether or not the Yucca Mountain site is a suitable location for a high-level waste repository, without in any way diminishing the regulatory authority of the NRC. While I am mindful that DOE must make the suitability determination, we will use an approach designed to involve others and to earn the trust and confidence of the public and scientific community.

## TESTIMONY FOR NNWSC

I would like to thank Chairman Graham and members of the Subcommittee on Nuclear Regulation for this opportunity to address a topic that is of vital concern to all Nevadans.

No doubt you have heard and read more than your fill of the clamor and fuss emanating from Nevada about possibly placing the country's first high-level nuclear waste repository at Yucca Mountain, located about 100 miles northwest of Las Vegas. Many people in Nevada, particularly in southern Nevada, are understandably concerned about the safety factor involved in placing a repository there and about transportation of wastes along Nevada highways.

Members of the Nevada Nuclear Waste Study Committee (NNWSC) fall into that category. All 9,000 of our members want to ensure that safety is the primary factor when considering whether Yucca Mountain is a suitable location. But we believe that the only way to determine whether Nevada is a safe place for the repository is to study the site, using every available means of scientific research, data, and personnel available.

Because we feel so strongly about continuing the scientific studies, the committee has yet to commit to a position on the Yucca Mountain issue. We believe that no one can be truly prepared to make a decision until all the facts are in. That has been our belief since the committee was begun in 1986, and it will continue to be our position until the last scientific study is completed and all the data is assimilated.

In terms of who we are, the NNWSC is a volunteer citizens committee whose members run the gamut in terms of professions and educational background. Many of our members are scientists, engineers and educators, but we also have a substantial number of members who hold blue-collar positions and are concerned about the way the state is handling the Yucca Mountain issue. Our members convey the committee's primary message -- to continue the scientific studies -- in a number of ways: through a speakers bureau, informal meetings, a bi-monthly newsletter, letters to the editor, and providing timely information to the news media.

Another important part of our program, other than urging the fine citizens of Nevada not to jump to hasty conclusions before the studies are completed, is convincing Nevada's political leaders that they are doing their constituents irreparable harm by not negotiating for benefits from the federal government. The site selection process, as you are aware, is a lengthy, arduous one due to the highly complex, technical nature of the studies. Dealing with these studies and the possibility of a repository has very real physical, social and economic impacts on the state. It only makes sense, then, that the state should receive monetary compensation. Should the Yucca Mountain site be approved for the repository, the nature of burden assumed by Nevada would seem to dictate even larger financial off-sets.

Unfortunately, our state's leaders have used the concept of monetary negotiations as a means of attacking the very entities that are trying to help Nevada. They have refused to participate in any discussions involving these monies, instead accusing a well-meaning Congress of trying to "bribe" them. The NNWSC would like to reassure the members of this subcommittee, as well as the entire Congress, that these politicians by no means speak for everyone in Nevada.

As evidenced by two recent polls conducted shortly after the recent 9th Circuit Court of Appeals decision to allow the Department of Energy to continue its Yucca Mountain studies, Nevadans are growing weary of the way their state leaders are handling this issue. Although these two polls were unscientific, they are reflective of many Nevadans' viewpoints.

On September 20, a Las Vegas television station asked its viewers to phone in their opinion about whether Nevada should continue its battle to prevent Yucca Mountain from being named as the repository site. Of the 1,493 calls received by the station, 63 percent said the state should stop fighting the federal government about Yucca Mountain.

Similarly, the results of a newspaper poll published September 21 in the Las Vegas Review-Journal show that 88 percent of the poll's respondents felt Nevada should no longer try to prevent further scientific studies.



We believe Nevadans are realizing that their leaders' political antics will have an irrevocable and harmful effect on future generations throughout the state. As a result, Nevadans are beginning to speak out. They are urging our leaders to adopt a more level-headed, moderate approach. Each day more of us understand the importance of nuclear energy as a means of addressing our oil import dependence. We understand, too, the relationship between locating a high-level waste repository and the future of nuclear energy in this country.

Regardless of whether our state leaders listen to the wishes of their constituents, the NNWSC would like the subcommittee members to know about the growing measure of support for continued studies of Yucca Mountain and for opening of negotiations for an equitable benefit package.

Again, thank you for the opportunity to express our views and insights and to participate in the subcommittee hearing process.

*Hugh J. Anderson III*  
*by lcc*

Hugh J. Anderson III  
Co-Chairman

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